

# City and Guilds of London Institute.

(INCORPORATED BY ROYAL CHARTER.)

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Mr. A. L. SOPER, Assistant Secretary.

# CITY AND GUILDS OF LONDON INSTITUTE.

(Incorporated by Royal Charter).

The City and Guilds of London Institute was founded in 1878, incorporated under the Companies Acts in 1880, and received the grant of a Royal Charter by Her late Majesty Queen Victoria in 1900. It is an association of the Corporation and Livery Companies of the City of London, instituted "for the purposes of all such branches of Science and the Fine Arts as benefit or are of use to or may benefit or be of use to productive and technical industries especially and to commerce and industry generally or any branch thereof and for the utilization of such means as will promote the several exclusive purposes aforesaid."

The management of the Institute and its branches is vested in the Members, Council, and Executive Committee, composed of representatives appointed by the Corporation, and the following Livery Companies of London contributing to its funds, namely, the Mercers', Grocers', Fishmongers', Goldsmiths', Skinners', Merchant Taylors', Salters', Ironmongers', Vintners', Clothworkers', Dyers', Leathersellers', Pewterers', Cutlers', Armourers and Brasiers', Saddlers', Carpenters', Cordwainers', Plaisterers', and Coopers', and of certain *ex officio* Members.

The operations of the Institute are divided broadly into four branches :— (1) The City and Guilds (Engineering) College ; (2) The City and Guilds Technical College, Finsbury ; (3) The City and Guilds South London Technical Art School ; and (4) the Department of Technology of the Institute.

(1.) The City and Guilds (ENGINEERING) COLLEGE, Exhibition Road, S.W., forms the Engineering Section of the Imperial College of Science and Technology, and is conducted by a Delegacy representing the Imperial College, the City and Guilds of London Institute, and the Goldsmiths' Company. The courses of instruction cover a period of three years, and are in Civil and Mechanical Engineering and in Electrical Engineering. They commence once a year in October, after the Matriculation or Entrance Examination of the College, and necessitate the attendance through the Session. The diploma of Associate of the City and Guilds of London Institute (A.C.G.I.) is awarded by the Council of the Institute to matriculated students who have gone through a complete course with sufficient merit. The age of admission is over 16 years. The fee for matriculated students attending a diploma course is £38 a session, if paid in advance.

The College was included as a SCHOOL OF THE UNIVERSITY OF LONDON in the Faculty of Engineering under the Statutes made for the University by the Commissioners appointed under the University of London Act 1898.

The Programme of the College, containing full particulars of the conditions of entrance, fees and courses of instruction, may be had on application.

(2.) The City and Guilds TECHNICAL COLLEGE, FINSBURY, provides day courses of instruction in Electrical Engineering, Mechanical Engineering, and Chemistry, and evening classes in the same subjects and in Applied Art. The day courses cover a period varying from two to three years. The

College is provided with laboratories and workshops, and the scheme of instruction is of an intermediate grade ; it occupies the position of a finishing technical school for those entering industrial life at a comparatively early age ; of a supplementary technical college, for those who, having had some industrial experience, desire to qualify themselves to become foremen or managers ; and of an intermediate college in the educational scheme of the Institute leading up to the Central Technical College. A Certificate is awarded by the Institute to Students, who have passed through one of the complete day courses of instruction with sufficient merit. The age of admission to the day department is 15 years. There is an entrance examination once a year in September and the fee for the session is £20 if paid in advance.

The programme of the College, containing full particulars of the conditions of entrance, fees, courses of instruction, and list of past students, may be had on application ; also particulars of the evening classes held at the College.

(3.) The City and Guilds SOUTH LONDON TECHNICAL ART SCHOOL, 122-4, Kennington Park Road, embraces departments of Modelling, Drawing and Painting and House Decoration ; the classes are mostly held in the evening.

The Programme of the School, giving particulars of the classes and fees, may be had on application.

(4.) The object of the Institute's DEPARTMENT OF TECHNOLOGY, Exhibition Road, S.W., is the registration and inspection of classes in Technology, Domestic Subjects, and in Manual Training, and the holding of annual examinations in the subjects taught in such classes throughout the country and in the Colonies. The Programme of the Department, including regulations for registration and inspection, and for the award of Teachers' Certificates in Manual Training and Domestic Subjects, with Syllabuses, &c., is published by Mr. John Murray, Albemarle Street, London, and is obtainable through any bookseller. This Programme is not sold from the Head Office of the Institute nor from the Office of the Department of Technology.

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The following publications are issued by the Institute :—

Annual Report of the Council to the Members of the Institute for the year.

Conditions of tenure of Scholarships, Fellowships, and Studentships awarded by the Institute.

CITY AND GUILDS OF LONDON INSTITUTE,

Gresham College, Basinghall Street, E.C.

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# LIST OF THE CHIEF ALTERATIONS IN THE PROGRAMME FOR 1911-1912.

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*The Honours Grade Examinations of the Department will be termed Final Examinations, and the lower grades Grade I., Grade II., &c.*

<i>Subject.</i>	<i>Particulars.</i>
2. ALKALI MANUFACTURE.	The manufacture of nitric acid has been included in the Syllabus of Grade I.
7A. COAL TAR DISTILLATION.	} These Syllabuses are now included in the Programme.
7B. COAL TAR COLOURING MATTERS.	
12. IRON AND STEEL MANUFACTURE.	Candidates must pass Grade II. before proceeding to the Final Examination, and the regulations for Grades I. and II. have been slightly altered.
14. PHOTOGRAPHY: Section A.	The Syllabus has been slightly amended and enlarged.
19. BOOT AND SHOE MANUFACTURE.	The Syllabus has been redrafted and re-arranged in four Grades.
26. WOOLLEN AND WORSTED WEAVING.	Some minor alterations have been made in the syllabuses and regulations.
42. PLUMBERS' WORK ...	Candidates will in general be required to take all three Grades in order.
46. MECHANICAL ENGINEERING.	The regulations respecting the order in which candidates must take Grade I. and Grade II. have been altered.
52. MINE SURVEYING ...	The Syllabus for the Final Examination and the regulations have been revised.
54. CARPENTRY AND JOINERY.	The Syllabus has been re-written.
67. PLAIN COOKERY ...	All Candidates will be required to take the Practical Test which will be held prior to the Written Examination.
69. BUILDERS QUANTITIES.	Some minor additions have been made to the Syllabus.
73. TAILORS CUTTING ...	The Ordinary Grade Syllabus has been revised and simplified.
74. MOTOR CAR ENGINEERING.	The Syllabus has been re-drafted and re-arranged as a three years' course.
79. HEATING AND VENTILATION.	This Syllabus is now included in the Programme.
MANUAL TRAINING, WOODWORK AND METALWORK.	The Syllabus and regulations have been re-written.
EVENING SCHOOL TEACHERS' CERTIFICATES IN DOMESTIC SUBJECTS.	The Institute will hold an examination in Black-board Drawing, to enable Candidates to qualify in Drawing.

The lists of Works of Reference have been revised.

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## Officers:

### TECHNOLOGY COMMITTEE.

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SIR PHILIP MAGNUS, *Secretary.*

### EXAMINATIONS BOARD.

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T. MATHER, F.R.S., <i>Professor of Electrical Engineering at the City and Guilds College.</i>
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SILVANUS P. THOMPSON, D.Sc., F.R.S., <i>Professor of Applied Physics at the Technical College, Finsbury.</i>

G. UDNY YULE.

*Assistant Superintendent and Secretary to the Board.*

\* Nominated by the President of the Board of Education.

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A. L. JOHNSTON, Esq. . . . .	Breadmaking
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E. BEVAN, Esq. . . . .	Paper Manufacture
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LYONEL CLARK, Esq. . . . .	" "
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T. TAYLOR, Esq. . . . .	Cotton Manufacture
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H. C. SOPER, Esq. . . . .	Silk
D. SAUNDERS, Esq. . . . .	" Weaving
E. DOUGHTY, Esq. . . . .	Lace Manufacture
W. TERRIUS ROWLETT, Esq. . . . .	Framework Knitting and Hosiery
PROFESSOR A. FLEMING, D.Sc., F.R.S. . . . .	Electric Lighting
G. GORE, Esq., LL.D., F.R.S. . . . .	Electro-Plating and Deposition
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G. J. JACOBS, Esq. . . . .	" "
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F. ASHEY, Esq. . . . .	"
S. LEETHAM, Esq. . . . .	"
A. E. HUMPHRIES, Esq. . . . .	"
JOHN SLATER, Esq., B.A., F.R.I.B.A. . . . .	Brickwork and Masonry

# ACTING EXAMINERS FOR THE YEAR 1911-12.

## TECHNOLOGY.

1. Salt manufacture .. .. .	Mr. J. ALLAN.
2. Alkali manufacture .. .. .	Dr. J. LEWKOWITSCH.
3. Soap manufacture .. .. .	{ Mr. W. JAGO, F.C.S., F.I.C. Mr. W. T. CALLARD. Mr. G. B. SODDY. Mr. G. W. COX. Mr. O. H. PAUL. Mr. PERCY LEWIS.
4. Bread-making and Flour Confectionery ..	Mr. A. GORDON SALAMON
5. Brewing .. .. .	Mr. A. R. LING.
6. Spirit manufacture .. .. .	{ Mr. W. H. COLEMAN. Dr. J. C. CAIN.
7. Coal-Tar Distillation and Coal-Tar Products	Mr. B. E. NEWLANDS, F.C.S., F.I.C.
8. Sugar manufacture .. .. .	Dr. J. K. CROW.
9. Painters' Colours, Oils and Varnishes ..	Dr. J. LEWKOWITSCH.
10. Oils and Fats, including Candle manufacture	{ Mr. T. GLOVER.
11. Gas engineering and supply .. .. .	Professor W. GOWLAND, F.R.S.
12. Iron and Steel manufacture .. .. .	{ Mr. J. HÜBNER. Mr. G. LAKE.
13. Paper manufacture .. .. .	{ Mr. G. WATMOUGH WEBSTER, F.C.S., F.R.P.S. Mr. H. CHAPMAN JONES, F.I.C. Mr. C. W. GAMBLE.
14. Photography .. .. .	Mr. W. BURTON.
15. Pottery and Porcelain .. .. .	Mr. W. ROSENHAIN.
16. Glass manufacture .. .. .	{ Mr. J. T. WOOD. Dr. GORDON PARKER.
17. Dressing of Skins .. .. .	Mr. JOHN MAY.
18. Leather tanning .. .. .	{ Dr. E. KNECHT.
19. Boot and Shoe manufacture .. .. .	{ Mr. E. BENTZ.
20. Silk dyeing .. .. .	Mr. E. B. FRY.
21. Wool dyeing .. .. .	{ Mr. J. SMAIL. Mr. A. M. CHAPMAN.
22. Cotton dyeing .. .. .	{ Mr. W. H. COOK. Mr. NORMAN JONES.
23. Cotton and Linen bleaching .. .. .	Mr. J. CROMPTON.
24. Calico and Linen printing .. .. .	Mr. H. C. HOUSTON.
25. Woollen and Worsted spinning .. .. .	Mr. W. G. FRIZELLE.
26. Woollen and Worsted weaving and designing	Mr. R. SNOW.
27. Cotton spinning .. .. .	{ Mr. T. J. DONOHUE. Mr. W. BEDNELL.
28. Cotton weaving .. .. .	Mr. W. M. BELL.
29. Flax spinning .. .. .	Mr. T. MILNE.
30. Linen weaving .. .. .	Mr. J. FARMER, Jun.
31. Silk throwing and spinning .. .. .	Mr. ERNEST LEE.
32. Silk weaving .. .. .	{ Mr. W. NOBLE. Mr. J. E. TAYLOR.
33. Jute spinning .. .. .	Mr. FRANK BROADBENT.
34. Jute weaving .. .. .	{ Professor E. W. MARCHANT, D.Sc. Professor GIBBERT KAPP, M.Sc. Mr. A. C. EBORALL.
35. Lace manufacture .. .. .	Mr. W. E. HUGHES, B.A.
36. Framework knitting and Hosiery .. ..	Professor H. M. WAYNFORTH.
37a. Telegraphy .. .. .	{ Dr. LOUIS PARKES. Mr. W. CHALLONER. Mr. F. KNIGHT.
37b. Telephony .. .. .	
38. Electric Wiremen's Work .. .. .	
39. Electrical Engineering .. .. .	
40. Electro-metallurgy .. .. .	
41. Metal Plate work .. .. .	
42. Plumbers' work .. .. .	



# ACTING EXAMINERS, 1911-12.

## TECHNOLOGY—continued.

43. Silversmiths' work and Plated Wares ..	Mr. ALEXANDER FISHER
44. Goldsmiths' work and Personal Ornaments ..	Mr. H. WILSON.
45. Watch and Clock making .. .. .	{ Mr. T. D. WRIGHT. Mr. W. BARBER.
46. Mechanical Engineering .. .. .	{ Prof. E. G. COCKER. Mr. F. C. LEA.
47. Road Carriage building .. .. .	Mr. WILLIAM PHILLIPSON.
48. Rail Carriage building .. .. .	Mr. A. J. HILL.
49. Typography .. .. .	{ Mr. F. HEDGER. Mr. A. R. CLOSH.
50. Lithography .. .. .	Mr. F. W. SEELEY.
51. Occurrence raising and dressing of Ores ..	Professor S. HERBERT COX, A.R.S.M.
52. Mine surveying .. .. .	Mr. L. H. COOKE.
53. Slate quarrying .. .. .	Mr. G. J. WILLIAMS.
54. Carpentry and Joinery .. .. .	{ Mr. F. G. RICE. Mr. W. T. SWEET.
55. Ship-builders' work... .. .	{ Mr. P. A. HILLHOUSE. Mr. T. H. WATSON.
56. Boilers Makers' work .. .. .	Mr. D. GEDDES.
57. Brickwork .. .. .	{ Mr. F. HIGGS. Mr. G. BIRD GODSON.
58. Masonry .. .. .	{ Mr. F. HIGGS. Mr. E. J. HILL.
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62. Cabinet making .. .. .	{ Mr. CHARLES BESSANT. Mr. J. D. JAMESON.
63. Bookbinding .. .. .	Mr. D. COCKERELL.
64. Dressmaking .. .. .	Miss AMY K. SMITH.
65. Millinery .. .. .	{ Miss K. M. BUCK. Miss J. E. CROAGER.
66. Plain Needlework .. .. .	Miss AMY K. SMITH.
67. Plain Cookery .. .. .	Miss MAUD R. TAYLOR.
68. Basket work .. .. .	Mr. T. OKEY.
69. Builders' Quantities.. .. .	Mr. L. BROWN.
70. Wheelwrights' work .. .. .	Mr. F. W. ROBSON.
71. Leather Dyeing .. .. .	{ Mr. J. T. WOOD. Dr. GORDON PARKER.
72. Principles of Art in Pattern Designing ..	Mr. WALTER CRANE.
73. Tailors' Cutting .. .. .	Mr. F. B. BARRATT.
74. Motor Car Engineering .. .. .	Mr. L. H. HOUNSFIELD.
75. Embroidery .. .. .	Mrs. A. H. CHRISTIE.
76. Engraving for Calico Printers .. .. .	Mr. ROBERT HAMILTON.
77. Engineers Quantities and Estimating ..	..
78. Structural Engineering .. .. .	Professor A. G. ASHCROFT, M.Inst.C.E.
79. Heating and Ventilation .. .. .	Mr. W. H. ATHERTON.

## MANUAL TRAINING. (TEACHERS' CERTIFICATE.)

Professor JOHN ADAMS.

Mr. A. WHILLIER.

Mr. H. WILLIAMS SMITH.

Mr. WALTER HEWSON.

Mr. J. H. JUDD.

## DOMESTIC SUBJECTS. (TEACHERS' CERTIFICATE.)

Professor JOHN ADAMS.

Mrs. RICHARDS.

Miss K. M. BUCK.

Miss A. K. SMITH.

Mrs. E. H. MORRIS.

Miss M. HOUSTON.

# REGULATIONS.

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The City and Guilds of London Institute is prepared, through its Department of Technology, and in accordance with its Regulations, to register Classes for instruction in Technology and in Domestic Subjects for Women, and Classes for Teachers in Manual Training and in Domestic Subjects, to inspect and report on the working of such Classes, and to hold Examinations in any of the subjects referred to in the following Regulations.

## REGISTRATION OF CLASSES.

1. Applications for the registration of Classes in Technology or in Domestic Subjects for Women or of Teachers' Classes in Manual Training or in Domestic Subjects, or for the renewal of the registration of such Classes previously registered, must be received at the Offices of the Department of Technology, Exhibition Road, not later than **Saturday, October 7th, 1911**. The Institute reserves to itself the right to refuse to accept any application received after that date, and, in the event of any such late application being accepted, to charge a fee, varying with the lateness of the application, from two shillings and sixpence to ten shillings.

2. In order that a School or Class may be registered :—

(A.) It must be under the direction of a suitably constituted Committee, and a person must be appointed to act as Secretary on behalf of the Committee. Any body of Managers appointed under Clause 2 of the "Regulations" of the Board of Education "for Technical Schools, &c.," will be accepted by the Institute as a suitable Committee.

(B.) The qualifications of the Teacher or Teachers must be approved by the Institute.

(C.) A return of the number of students in attendance at the Class must be forwarded to the Offices of the Department, Exhibition Road, on a Form\* which will be supplied, or may be obtained on application. This Form, duly filled in, must be received on or before **Saturday, November 4th, 1911**, and no class will be registered until after the receipt of this Form.

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\* Classes held in Schools in Scotland will, as a rule, be registered on the authorisation of the Secretary of the Scotch Education Department through whom the Forms required may be obtained.

3. The duties of the Local or School Committee are :—

- (A.) To watch the progress of the classes under their management, to visit such classes, and to examine and certify the register from personal knowledge of its accuracy. (See Rule 5.)
- (B.) To give encouragement and advice to those persons who may wish to join the classes, or to present themselves for examination.
- (C.) To arrange for the superintendence of the Examinations, in accordance generally with the Regulations of the Board of Education.
- (D.) To distribute the certificates and prizes forwarded from the Institute.

4. All sums, granted by the Institute for Prizes, will be paid to the Local or School Committees, and the prizetakers must look to such Committees for payment of such sums. The receipt of the Secretary or other accredited officer of the Local or School Committee will be a full discharge to the Institute for all liability in respect of such sums.

5. A register of attendances must be kept by the Teacher of every registered class, and a Form which will be supplied by the Institute, testifying to the attendances, must be forwarded to the Office of the Department immediately after the breaking up of the Class, and in any case not later than the date given in the Calendar of the Department.

6. The Institute reserves the right of requiring the inspection of any class by one of its Officers or by some other approved Inspector before registering it, or subsequently, if registered, and of refusing to comply with the application for the registration of any class or the approval of any Teacher.

7. The Local Education Authority should, in general, be responsible for the arrangements within its area relating to the registration of Classes and the conduct of the Institute's examinations.

#### TECHNOLOGY.—REGISTRATION OF TEACHERS.

8. Persons qualified as under may, on application to the Institute's Department of Technology, be registered as Teachers of Technological subjects :—

- (A.) Any person who has obtained a First-class Full Technological Certificate in the subject to be taught, and has

either passed the practical test, if any, or in the absence of such practical test, produces evidence satisfactory to the Department of possessing a sufficient practical experience of the trade or profession in question.

- (B.) Persons, recommended by the Local or School Committee and possessing special qualifications, which are considered satisfactory by the Institute.

Applications for the registration of persons possessing such special qualifications, and not qualified under clause (A), can only be considered when made by the Local Committee in connection with an application for the registration of a definite class.

Teachers registered by the Institute in any Technological subject are accepted by the Board of Education and by the Central Education Authorities for Scotland and Ireland.

9. When the Department is unable at once to approve the qualifications of a teacher submitted under Rule 8, the name of such teacher may be placed provisionally on the register, and the Department may require the teacher to enter for the examinations of the Board of Education or of the Institute before being fully registered ; the results obtained by the students of the Teacher at the Institute's Examinations may also be taken into consideration.

### EXAMINATIONS.

10. Examinations will be held at the close of the Session on the courses of instruction laid down in the Programme. Such examinations must be conducted under the direction of a Local or School Committee approved by the Institute. The Examinations in the majority of the technological subjects are in two grades. In subjects in which more than two successive courses of instruction are indicated, Examinations are held corresponding to each course.

11. Candidates who pass in either grade of any technological subject in which examinations are held in two grades only, will, as a rule, be arranged in two classes, and Certificates (First and Second Class) will be awarded to successful Candidates in each grade. In subjects in which examinations are held in more than two grades, certificates will be awarded on the results of the examinations in the two highest grades only.

12. Candidates who obtain a Second-class Certificate in either grade may be re-examined in any subsequent year for a First-class Certificate in the same grade, but failing to obtain sufficient marks to entitle them to a First-class Certificate, a second Certificate will not be

awarded to them. Candidates who have obtained a Prize at the Final Examination, a First-class Certificate at an examination in any lower grade, or a Pass in cases where the successful Candidates are not classified, will not be re-examined in the same grade of that subject. No Candidate may be examined in any subject in a lower grade than that in which he has already obtained a Certificate. No certificate will be awarded to any Candidate presenting himself a second time for examination, unless he attains a higher success than at his previous examination.

13. Prizes consisting of silver medals in the case of the Final Examination and bronze medals in the case of the examination of the next lower grade will be given in nearly all subjects to Candidates, other than teachers (see Rule 34), provided their merits justify the examiners in recommending the award. Money prizes are also offered on like conditions by several of the Livery Companies.

14. The Certificates and Prizes will be forwarded as soon as possible after the issue of the Pass Lists to the Secretaries of the Local or School Committees.

15. Intending Candidates for the Institute's Examinations must apply not later than the day named below (Rule 23) to the Secretary of the School at which they are attending, or to the Secretary of the nearest Science or Technical School, or to the Secretary of the Local Education Authority, who will arrange for their examination and forward their fees to the Offices of the Department of Technology, Exhibition Road, London.\* It is only in the case of candidates failing to make such local arrangements, and desiring to be examined at the offices of the Department in London, that any direct application to the Institute's Department of Technology can be considered.

16. If, in any subject, no examination is held, owing to a sufficient number of Candidates not having applied for examination (see Rule 18), *but in no other case*, the fee will be returned.

17. All written Examinations will be conducted by means of printed papers, and the answers must be written upon paper specially provided for the purpose. The question papers will be sent in sealed envelopes† to the custodian appointed to receive them on or immediately before the day of the Examination, and the envelope

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\* In the case of schools in Scotland applications for examination must be forwarded to the Scotch Education Department. [See Circular 363.]

† Secretaries who may require the question papers to be separately packed in different envelopes must make application to that effect, giving full particulars, twenty-one days at least before the date of the first Examination.

containing these papers must be opened in the presence of the Candidates at the time of the Examination. A number will be allotted to each Candidate, and he will be known to the Examiner by that number and not by name. The worked papers must be sealed up immediately on the termination of the Examination, and despatched, without delay, registered and *prepaid* to the offices of the Department, Exhibition Road, London, S.W.

18. The Examinations in Technology include the following subjects, but the Institute may decline to hold an Examination in any subject unless at least ten Candidates in the aggregate apply for examination. If, however, five Candidates, who have received instruction in any registered class, apply to be examined in any one grade of a subject, an examination will be held in that grade of the subject. No Candidate can be examined on the same day in more than one subject.

#### TECHNOLOGICAL SUBJECTS.

- |  |   |
|--|---|
| 1. Salt manufacture.                             | 27. Cotton spinning.  |
| 2. Alkali manufacture.                           | 28. Cotton weaving.   |
| 3. Soap manufacture.                             | 29. Flax Spinning.  |
| 4. Bread-making and Flour Confectionery.         | 30. Linen weaving.  |
| 5. Brewing.                                      | 31. Silk throwing and spinning.   |
| 6. Spirit manufacture.                           | 32. Silk weaving.   |
| 7. Coal-Tar Distillation and Coal-Tar Products.  | 33. Jute spinning.  |
| 8. Sugar manufacture.                            | 34. Jute weaving.   |
| 9. Painters' Oils, Colours and Varnishes.        | 35. Lace manufacture.   |
| 10. Oils and Fats, including Candle manufacture. | 36. Framework Knitting and Hosiery.                                     |
| 11. Gas engineering and supply.                  | 72. Principles of Art as applied to the Design of Patterns for Weaving. |
| 12. Iron and Steel manufacture.                  |   |
| 13. Paper manufacture.                           | 37. Telegraphy and Telephony.   |
| 14. Photography.                                 | 38. Electric Wiremen's Work.  |
| 15. Pottery and Porcelain.                       | 39. Electrical Engineering.   |
| 16. Glass manufacture.                           | 40. Electro-Metallurgy, &c.   |
|  |   |
| 17. Dressing of Skins.                           | 41. Metal Plate Work.   |
| 18. Leather tanning.                             | 43. Silversmiths' Work.   |
| 71. Leather dyeing.                              | 44. Goldsmiths' Work.   |
| 19. Boot and Shoe manufacture.                   | 45. Watch and Clock Making.   |
|  |   |
| 20. Silk dyeing.                                 | 46. Mechanical Engineering.   |
| 21. Wool dyeing.                                 | 55. Ship Builders' Work.  |
| 22. Cotton dyeing.                               | 56. Boilermakers' Work.   |
| 23. Cotton and Linen bleaching.                  | 74. Motor Car Engineering.  |
| 24. Calico and Linen printing.                   | 77. Engineers' Quantities.  |
| 76. Engraving for Calico Printers.               | 78. Structural Engineering.   |
|  | 79. Heating and Ventilation.  |
|  |   |
| 25. Woollen and Worsted spinning.                | 47. Road Carriage building.   |
| 26. Woollen and Worsted weaving and designing.   | 48. Rail Carriage building.   |
|  | 70. Wheelwrights' Work.   |

- 49. Typography.
- 50. Lithography.
- 63. Book binding.

51. The Occurrence, Raising and Dressing of Ores.

- 52. Mine surveying.
- 53. Slate quarrying.

42. Plumbers' Work.

- 54. Carpentry and Joinery
- 57. Brickwork.
- 58. Masonry.
- 59. Plasterers' Work.
- 60. Painters' and Decorators' Work.
- 69. Builders' Quantities.

- 61. Milling (Flour Manufacture).
- 62. Cabinet Making.
- 68. Basket-Work.
- 73. Tailors' Cutting.

19. Examinations for women will be held in the following subjects:—

- 64. Dressmaking.
- 65. Millinery.

- 66. Plain needlework.
- 67. Plain cookery.

75. Embroidery.

20. The examinations in many subjects include practical tests of workmanship, but such practical tests can be held at those Centres only where the necessary arrangements can be made. In several subjects, Candidates are required to submit specimens of their work as part of their examination. Every such specimen must be accompanied either by a Statutory Declaration signed before a Magistrate or a Commissioner for Oaths, or by a Certified Statement (forms for which may be obtained from the Institute's Department of Technology) to the effect that the work has been done by the Candidate alone.

21. No member or officer of a Local or School Committee is eligible for examination.

22. The Examinations in Technology for the year 1912 will be held on the dates given on pp. 21 to 25.

23. Applications for Examinations in Technology (including the Examinations for Women) should be made to the Local or School Secretary or to the Secretary of the Local Education Authority not later than **March 13th, 1912**, and Secretaries must forward their returns, on Forms to be obtained from the Institute, together with examination fees, so as to reach the Offices of the Department not later than **March 18th, 1912**. Applications may, in exceptional cases, be received so far as the office arrangements permit after that date, but an extra fee of One Shilling will be charged for each question paper supplied in response to such applications until **March 30th**, after which date the extra fee will be **Two Shillings**.\*

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\* Secretaries are requested to note that it is difficult to accept late applications for examination in any subject in which material for a practical test is supplied by the Institute. They are also requested to note the footnote on p. 10 as to instructions for the special packing of question papers.

24. Applications for Examination at the Offices of the Department must be accompanied by a fee of One Shilling and Sixpence in addition to the fee for the Examination as stated in the Programme.

*For further particulars of the Conditions of Examination in any of the above-named Subjects, see Syllabus of each subject.*

## CERTIFICATES.

25. The Institute's Certificates in nearly all subjects are of two kinds, according as Candidates have or have not received regular instruction in a Class registered by the Institute.

26. The one kind of Certificate is granted to those Candidates only who pass the Institute's Examination, and give evidence of having made during the preceding session at least 20 attendances on 20 separate days in a Class registered by the Institute in the subject of examination. The name of the Institution in which the Candidate has received his training will be inscribed on the Certificate.

27. The second kind of Certificate is given to Candidates who pass the Institute's Examination, but who may not have attended any registered class, or who have not made at least 20 attendances at such a Class during the preceding session.

28. Classes in technological subjects held in any University of the United Kingdom, or in any University College participating in the Parliamentary grant, will be considered as registered classes, and Candidates from such classes will be eligible for the former of the two kinds of Certificate (Rule 26).

29. To obtain a Full Technological Certificate in the majority of the above-mentioned technological subjects (Rule 19), Candidates will be required to pass the Institute's Final Examination in Technology, and also, in general, an examination in Stage II., at least, in two of the Science subjects included in the "Regulations for Technical Schools, &c." of the Board of Education, the subjects to be chosen from those most closely allied to the subjects of the Candidate's Technical Instruction. [For detailed regulations, see the syllabus of each subject.]

Students are advised to attend group courses, approved by the Board of Education, and should consult their teachers as to the



most suitable Science and Art subjects to be studied with a view to the Full Technological Certificate. As a rule, instruction in Science should precede instruction in Technology, and Candidates are expected to pass the examinations in Science or Art, qualifying for a Full Technological Certificate, before presenting themselves for the Final Examination in Technology.

30. The Institute will accept as alternative evidence of a candidate's knowledge of the necessary Science subjects :—

- (1.) A Certificate stating that the Candidate has passed an examination in the qualifying branches of Science at one of the Universities of the United Kingdom or its Colonies.
- (2.) Certificates from the Professors of any University of the United Kingdom or its Colonies, or of any University Collège participating in the Parliamentary grant, or from the Recognised Teachers of the University of London, stating that the candidate has attended approved courses of instruction under the Professors or Recognised Teachers in the Science or Art subjects allied to the technological subject in which the Full Certificate is claimed, and has passed a satisfactory Examination in such Science subjects.
- (3.) A Certificate from the Scotch Education Department to the effect that the Candidate has attended approved courses of instruction in the qualifying subjects, and has passed a satisfactory examination in such subjects.

31. The Full Technological Certificate granted to Candidates who have qualified as above in Science and Art, or have otherwise satisfied the Institute as to their knowledge of the qualifying subjects, will be stamped by the Board of Education as issued under conditions approved by the Board.

32. Candidates who pass the Final Examination in Technology alone without satisfying the Institute as to their knowledge of the principles of Science and Art cognate to the subject of examination, will in general receive a Provisional Certificate. This will be exchanged for a Full Technological Certificate whenever they produce evidence of having fulfilled the requirements of Rule 29 or 30. (For special rule, respecting Electrical Engineering see p. 176.)

33. In addition to the Full Technological Certificate, the Institute grants a pocket parchment Certificate to any Candidate qualified for

the first-class Full Technological Certificate of any one of the following subjects :—

- |   |  |
|---|--|
| 4. Breadmaking and Flour Confectionery.         | 43. Silversmiths' Work.                      |
| 7. Coal Tar Distillation and Coal Tar Products. | 44. Goldsmiths' Work.                        |
| 9. Manufacture of Painters' Oils, &c.           | 45. Watch and Clock Making.                  |
| 14. Photography.                                | 46. Mechanical Engineering.                  |
| 19. Boot and Shoe Manufacture.                  | 49. Typography (Compositors).                |
| 26. Woollen and Worsted Weaving.                | 52. Mine Surveying.                          |
| 28. Cotton Weaving.                             | 51. Carpentry and Joinery.                   |
| 30. Linen Weaving.                              | 57. Brickwork, including the Practical Test. |
| 32. Silk Weaving.                               | 58. Masonry including the Practical Test.    |
| 34. Jute Weaving.                               | 60. Painter and Decorators' Work.            |
| 42. Plumbers' Work.                             | 63. Bookbinding.                             |
|   | 75. Embroidery.                              |

provided the Candidate produces evidence of having regularly attended for two sessions at least, a registered class in the Technology of the subject and classes in allied branches of Science and Art.

A Parchment Certificate in Subject 38, Electric Wiremen's Work, will be awarded to any Candidate obtaining a first-class Certificate at the Final Examination.

34. Teachers, or persons registered as teachers, are eligible for Certificates, but not for prizes. They must be examined in accordance with the rules laid down by the Board of Education for the examination of teachers in Science, and any teacher so examined, who obtains the number of marks qualifying for a prize, will receive a Certificate, on which it will be stated that he is disqualified from receiving a prize owing to the fact that he is or has been a Teacher. In such cases the Teacher cannot be informed as to the order of prize for which he might have been qualified.

### TEACHERS' CERTIFICATES IN MANUAL TRAINING AND DOMESTIC SUBJECTS.

35. Teachers' Certificates in Manual Training are issued by the Institute in accordance with the special regulations for the award of such Certificates, and are recognised by the Board of Education, by the Scotch Education Department, and by the Department of Agriculture and Technical Instruction for Ireland, as affording evidence of competence to teach the subject or subjects covered by the Certificate.

36. Teachers' Certificates in Manual Training are granted in Woodwork and in Metalwork. For regulations as to registration of Classes, see p. 7, Rules 1 and 2, and for full particulars and con-

ditions of examination see "Regulations for award of Teachers Certificates in Manual Training," p. 310.

37. Evening School Teachers' Certificates in Plain Needlework, in Dressmaking, and in Millinery qualifying the holders to give instruction in those subjects, are issued by the Institute on the results of the examination of Students of Classes registered as Teachers' Training Classes.

For full particulars and conditions of examinations, see p. 321.

## REPORTS ON RESULTS OF EXAMINATION OF CLASSES.

38. With the view to enable Local Education Authorities or School Managers to obtain more detailed information as to the manner in which the students of the Classes under their direction have passed the Institute's Annual Examinations, a special report will be forwarded, provided the necessary arrangements can be made, on the results of the Examination of the candidates who have received instruction in any registered Class. The report will refer to the work of the students generally presented for examination, and not to that of any selected students.

39. Applications for such special reports should be made by the Secretary of the Local Education Authority or by the Secretary of the Technical School in which the Candidates have received instruction, and should reach the Offices of the Department on or before April 27th, 1912.

40. The fees payable to the Institute for a special report are 10s. for any one Class consisting of not more than 10 candidates, and an additional 10s. for every additional 10 or fraction of 10 candidates who may present themselves from that Class, provided that the application be received on or before April 27th; but if the application be received after that date, but early enough for the necessary arrangements to be made, these charges will be increased by one-half.

## INSPECTION.

41. The Institute is recognised by the Board of Education as an agency for the inspection of Schools other than elementary in technological subjects, Manual Training and Domestic Subjects, and is prepared to undertake the inspection of any School or Class giving instruction in those subjects.

42. Applications for the inspection of a School or Class should be forwarded to the Superintendent and addressed to the Department of Technology, City and Guilds of London Institute. All arrangements for inspection will be made by the Superintendent in consultation with the Local Authority and the Inspectors.

43. At least one month's notice must be given by the Local Authority of any inspection that may be required.

44. Prior to the inspection an estimate of the amount of time likely to be required, and the probable cost, will, if desired, be sent from the Institute's Department of Technology to the Local Authority.

45. The ordinary fees to be charged by the Institute for an inspection are as follows :—A fee of £1 5s. for each day or evening, and a sum of 15s. for each night spent away from home, with second or third class railway fare, for each Inspector engaged. These charges include expenses of maintenance during the inspection, but do not include the cost of printing the Report.

46. In certain subjects, and when the notice given (Rule 43) is insufficient, higher fees may be charged. Where an inspection occupies a week or more, special terms may be arranged by the Institute with the Local Authority.

#### POSTAGE.

47. *The postage on all letters, and the carriage on all parcels, cases, &c., forwarded to the Offices of the Department, must be prepaid.*

*(For regulations as regards forwarding of Specimen Work, &c., see p. 19.)*

All communications on the subject of the Recognition or Registration of Schools or Classes, the Examinations in Technology, Manual Training and Domestic Subjects, or with respect to the Inspection of Schools or Classes, to be addressed :

“THE SUPERINTENDENT,

“DEPARTMENT OF TECHNOLOGY,

“CITY AND GUILDS OF LONDON INSTITUTE,

“Exhibition Road,

“London, S.W.”

Particulars of the Money Prizes (Rule 13) offered for competition by the Livery Companies will be found on pp. 332-340. Reference to the Scholarships and Prizes offered by the Worshipful Company of Drapers and other public bodies on the results of the Institute's Examinations will be found in the syllabuses of the subjects in connection with which the offers are made.

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Copies of this Programme, price *ninepence net* (postage extra), may be obtained from any bookseller; or from the publisher, Mr. JOHN MURRAY, Albemarle Street, London. *The Programme is not sold at the Offices of the Institute.*

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*Secretaries or Candidates are particularly requested to observe the following General Rules when forwarding Specimens, Packages, &c., to the Department :—*

- (1.) The carriage on all parcels, cases, &c., excepting that containing the work executed at the Practical Examination in Grade II. of Plumbers' work, forwarded to the Department must be prepaid. *Specimens of work are returned by the Department "carriage forward."*
- (2.) All practical and specimen work should be forwarded through the Local Secretary, to whom, unless otherwise directed, its receipt by the Department will be acknowledged.
- (3.) The name of the Candidate or of the centre of examination must not appear on any specification, drawing, or piece of work submitted for examination. A detachable label may be used. (Special instructions are given for the special Subjects for Women, 64, 65, 66, and 75, *vide* Syllabus of each Subject.)
- (4.) Drawings, where too large to be enclosed with work, may be sent rolled separately, but must be accompanied by a Certified Statement, or, where the work has not been executed in the School or Employer's Workshop, by a Statutory Declaration form, duly filled in.
- (5.) Each Candidate's work should, if possible, be enclosed in a separate box.
- (6.) A card giving name of sender and full address for return should be tacked to underside of lid.
- (7.) The lids of cases, &c., should be battened, and screws alone should be used for fastening down the lid.
- (8.) All works intended for examination (except where otherwise directed), should be addressed as follows :—

DEPARTMENT OF TECHNOLOGY,  
CITY AND GUILDS OF LONDON INSTITUTE,  
EXHIBITION ROAD,  
LONDON, S.W.,

marked "carriage paid," and the address label should indicate the subject of examination for which the contents are intended.

- (9.) The Officers of the Institute exercise all possible care in returning to Candidates their specimens of workmanship submitted. They cannot, however, hold themselves responsible for any loss or damage that may unavoidably occur.

# CALENDAR.

- SATURDAY, OCTOBER 7TH, 1911** Last day for receiving from Local Secretaries Applications for registration of classes in Technology (including Special Subjects for Women), and of Teachers Training Classes in Manual Training and Domestic Subjects.
- SATURDAY, NOVEMBER 4TH, 1911** Last day for receiving from Local Secretaries returns of numbers of Students in attendance at registered classes.
- SATURDAY, JANUARY 27TH, 1912** Particulars of Exercises for the Practical Examination in Painters' and Decorators' Work will be sent to Local Secretaries on or before this date.
- SATURDAY, MARCH 2ND . . .** Last day for holding Preliminary Local Practical Examinations in Photography.
- MONDAY, MARCH 11TH . . .** Last day for receipt of entries for Drapers' Company's Exhibitions and Scholarships.
- WEDNESDAY, MARCH 13TH . . .** Candidates must send in their entries to Local Secretaries before this date.
- MONDAY, MARCH 13TH . . .** Last day for receiving from Local Secretaries Applications and Fees for Examinations in Technology.
- MONDAY, MARCH 25TH . . .** Last day for receiving from Local Secretaries Applications and Fees for Examinations in Manual Training.
- THURSDAY, MARCH 28TH . . .** Last day for Candidates in Painters' and Decorators' Work to forward to London their Specimens of Practical Work.
- SATURDAY, APRIL 13TH . . .** Data and Material for the Practical Examination in Mechanical Engineering (Final) will be sent to Local Secretaries on or before this date.
- SATURDAY, APRIL 27TH . . .** Examinations commence. For time and date of each Examination see pages 21-25.
- MONDAY, APRIL 29TH . . .** Last day for receiving from Candidates in Weaving, Photography, Metal Plate Work, Road Carriage Building, Mine Surveying, Ship Builders' Work, Plasterers' Work, Cabinet-Making, Bookbinding, and Basket-Work Specimens of Practical Work or Designs.
- MONDAY, MAY 13TH . . .** Last day for Final Candidates in Carpentry and Joinery to forward to the Institute specimens of their Practical Work.
- WEDNESDAY, MAY 15TH . . .** Last day for Final Candidates in Mechanical Engineering (Division A, Machine Designing) to return their Designs.
- WEDNESDAY, MAY 22ND . . .** Last day for Candidates in Mechanical Engineering (Final) to return Practical Work (Division B, Workshop Practice).  
Last day for Final Candidates in Road Carriage Building and Wheelwrights' Work to return their Designs.  
Last day for receiving from Local Secretaries Registers or Certificates of attendance at registered classes in Technology and Manual Training.
- THURSDAY, MAY 30TH . . .** Last day for receiving from Local Secretaries Applications and Fees for Examinations for Evening School Teachers' Certificates in Domestic Subjects.

# DATES OF EXAMINATIONS, 1912.

## TECHNOLOGY.

1	Salt manufacture ... ..	Wednesday, May 1st ...	7.0 to 10.0 p.m.
2	Alkali manufacture... ..	" "	" "
3	Soap manufacture ... ..	" "	" "
4 a.	Bread-making (Written) ... ..	Tuesday, April 30th ...	" "
	Do. Grade I (Practical)	Dates and hours to be subsequently fixed.	
	Do. Final (Practical)		
4 b.	Confectionery (Written) ... ..	Wednesday, May 1st ...	7.0 to 10.0 p.m.
	Do. Grade I (Practical)	Dates and hours to be subsequently fixed.	
	Do. Final (Practical)		
5	Brewing ... ..	Wednesday, May 1st ...	7.0 to 10.0 p.m.
6	Spirit manufacture .. ..	" "	" "
7 a.	Coal-tar Distillation and Inter- mediate Products (Written) ...	Thursday, May 2nd ...	" "
	Do. Final (Practical)	Saturday, May 4th ...	2.30 to 7.30 p.m.
7 b.	Coal-tar Colouring Matters (Written)	Thursday, May 2nd ...	7.0 to 10.0 p.m.
	Do. Final (Practical)	Saturday, May 4th ...	2.30 to 7.30 p.m.
8	Sugar manufacture ... ..	Tuesday, April 30th ...	7.0 to 10.0 p.m.
9	Painters' Oils, Colours, &c. (Written)	Wednesday, May 1st ...	" "
	Do. Final (Practical)	Saturday, May 4th ...	2.30 to 6.30 p.m.
10	Oils & Fats, including Candle mfr.	Wednesday, May 1st ...	7.0 to 10.0 p.m.
11 a.	Gas Engineering ... ..	Saturday, April 27th ...	2.30 to 6.30 p.m.
11 b.	Gas supply ... ..	Saturday, May 4th ...	" "
12	Iron and Steel manufacture—		
	Grade I ... ..	Monday, April 29th ...	7.0 to 10.0 p.m.
	Do. Grade II and Final ...	Tuesday, April 30th ...	" "
13	Paper manufacture ... ..	Saturday, May 4th ...	2.30 to 6.30 p.m.
14	Photography (Written) Section A	Tuesday, April 30th ...	7.0 to 10.0 p.m.
	Do. do. Section B	Wednesday, May 1st ...	" "
	Do. Final (Practical)		
	Section A	Saturday, May 4th ...	2.30 to 6.30 p.m.
	Do. do. Section B	" May 11th ...	2.30 to 7.30 p.m.
15	Pottery and Porcelain—Grade I ...	Monday, April 29th ...	7.0 to 10.0 p.m.
	Do. Grade II and Final	Wednesday, May 1st ...	" "
16	Glass manufacture—Grade I ...	Monday, April 29th ...	" "
	Do. Grade II and Final	Wednesday, May 1st ...	" "
17	Dressing of Skins ... ..	" "	" "
18	Leather Tanning ... ..	" "	" "
19	Boot & Shoe manufacture		
	Grade I (Written)	Monday, April 29th ...	" "
	Do. Grade II (Written)	Tuesday, April 30th ...	" "
	Do. Grade III and Final (Written)	Wednesday, May 1st ...	" "



20	Silk dyeing ... ..	Wednesday, May 1st ...	7.0 to 10.0 p.m.
21	Wool dyeing ... ..	" " "	" "
22	Cotton dyeing ... ..	Monday, April 29th ...	" "
23	Cotton and Linen bleaching ...	Wednesday, May 1st ...	" "
24	Calico and Linen printing ...	Tuesday, April 30th ...	" "
25	Woollen and Worsted Spinning—		
	Grade I ... ..	Monday, April 29th ...	" "
	Do. Grade II ... ..	Tuesday, April 30th ...	" "
	Do. Final ... ..	" "	" "
26	Woollen and Worsted weaving—		
	Grade I Div. I ... ..	Wednesday, May 1st ...	" "
	Do. Div. II ... ..	" "	" "
	Do. Grade II (Divs. I and II)	" "	" "
	First Paper ... ..	Thursday, May 2nd ...	" "
	Do. Grade II (Divs. I and II)	" "	" "
	Second Paper ... ..	Saturday, May 4th ...	2.30 to 6.30 p.m.
	Do. Final (Divs. I and II)	Saturday, April 27th ...	" "
	Do. do. (Section A)	Saturday, May 4th ...	" "
	Do. do. (Section B)	Saturday, May 11th ...	" "
27	Cotton Spinning—Grade I ...	Monday, April 29th ...	7.0 to 10.0 p.m.
	Do. Grade II ...	Tuesday, April 30th ...	" "
	Do. Final (Sect. A)	Wednesday, May 1st ...	" "
	Do. " (Sect. B)	" "	" "
28	Cotton weaving—Grade I ...	Saturday, May 4th ...	2.30 to 6.30 p.m.
	Do. Grade II ...	Saturday, May 11th ...	" "
	Do. Final (Section A)	Saturday, May 4th ...	" "
	Do. " (Section B)	Saturday, May 11th ...	" "
29	Flax spinning ... ..	Tuesday, April 30th ...	7.0 to 10.0 p.m.
30	Linen weaving—Grade I ...	Monday, April 29th ...	" "
	Do. Grade II ...	Tuesday, April 30th ...	" "
	Do. Final (General) ...	Wednesday, May 1st ...	" "
	Do. do. (Section A)	Saturday, May 4th ...	2.30 to 6.30 p.m.
	Do. do. (Section B)	Thursday, May 2nd ...	7.0 to 10.0 p.m.
31	Silk throwing and spinning ...	Monday, April 29th ...	" "
32	Silk weaving ... ..	Saturday, May 4th ...	2.30 to 8.0 p.m.
33	Jute spinning ... ..	Monday, April 29th ...	7.0 to 10.0 p.m.
34	Jute weaving—Grade I ...	Thursday, May 2nd ...	" "
	Do. Grade II ...	Saturday, May 4th ...	2.30 to 6.30 p.m.
	Do. Final (General) ..	Wednesday, May 1st ...	7.0 to 10.0 p.m.
	Do. do. (Section A)	Saturday, May 4th ...	2.30 to 6.30 p.m.
	Do. do. (Section B)	Thursday, May 2nd ...	7.0 to 10.0 p.m.
35	Lace manufacture ... ..	Tuesday, April 30th ...	" "
36	Framework Knitting and Hosiery	" " "	" "
37 a.	Telegraphy—Grade I ...	Monday, April 29th ...	" "
	Do. Final ... ..	Thursday, May 2nd ...	" "
37 b.	Telephony—Grade I ...	Wednesday, May 1st ...	" "
	Do. Final ... ..	Thursday, May 2nd ...	" "
38	Wiremen's work (Written) Grade I	Tuesday, April 30th ...	7.0 to 10.0 p.m.
	Do. (Practical) Grade I	Saturday, May 4th ...	3.0 to 6.0 p.m.

39	Electrical Engineering—Grade I ...	Monday, April 29th ...	7.0 to 10.0 p.m.
	Do. do. Grade II	" " ...	" "
	(1st Paper)	" " ...	" "
	Do. do. Grade II	" " ...	" "
	(2nd Paper)	Wednesday, May 1st	" "
	Do. do. Final	" " ...	" "
	(1st Paper)	Monday, April 29th ...	" "
	Do. do. Final	" " ...	" "
	(2nd Paper)	Wednesday, May 1st ...	" "
40	Electro-metallurgy—Grade I ...	Monday, April 29th ...	" "
	Do. Grade II and	" " ...	" "
	Final	Tuesday, April 30th ...	" "
41	Metal Plate work ...	Thursday, May 2nd ...	" "
42	Plumbers' work—Grade I ...	Monday, April 29th ...	" "
	Do. Grade II and Final	" " ...	" "
	(Written)	Thursday, May 2nd ...	" "
	Do. Grade II (Practical)	Saturday, May 11th ...	2.30 to 8.0 p.m.
	Do. Final (Practical)	Saturday, May 18th ...	" "
43	Silversmiths' work (Written) ...	Tuesday, April 30th ...	7.0 to 10.0 p.m.
	Do. (Practical) Grade I	Monday, May 6th ...	6.0 to 10.0 p.m.
	Do. do. Final	{ Monday, May 6th, and } 7.0 to 10.0 p.m.	
		{ Tuesday, May 7th } each day.	
44	Goldsmiths' work (Written) ...	Wednesday, May 1st ...	7.0 to 10.0 p.m.
	Do. (Practical) Grade I	Wednesday, May 8th ...	6.0 to 10.0 p.m.
	Do. do. Final	{ Wednesday, May 8th, & } 7.0 to 10.0 p.m.	
		{ Thursday, May 9th } each day.	
45	Watch and Clock making (Written)	Thursday, May 2nd ...	7.0 to 10.0 p.m.
	Do. Final (Practical)	Saturday, May 4th ...	2.30 to 7.0 p.m.
46	Mechanical Engineering—Grade I	Tuesday, April 30th ...	7.0 to 10.0 p.m.
	Do. Grade II	" " ...	" "
	Do. Final (Written)	Thursday, May 2nd ...	" "
47	Road Carriage building ...	" " ...	" "
48	Rail Carriage building (Written)...	" " ...	" "
	Do. do. Final (Drawing)	Saturday, May 4th ...	2.30 to 6.30 p.m.
49	Typography—Grade I ...	Monday, April 29th ...	7.0 to 10.0 p.m.
	Do. Grade II and Final (Written)	Tuesday, April 30th ...	" "
	Do. Grade II (Practical for	" " ...	" "
	Compositors)	Saturday, April 27th ...	2.30 to 7.0 p.m.
50	Lithography—Grade I ...	Monday, April 29th ...	7.0 to 10.0 p.m.
	Do. Grade II and Final ...	Wednesday, May 1st ...	" "
51	Occurrence, Raising, and Dressing } of Ores }	" " ...	" "
52	Mine Surveying—Grade I ...	Monday, April 29th ...	" "
	Do. Grade II and Final	" " ...	" "
	(Written)	Tuesday, April 30th ...	" "
53	Slate Quarrying ...	Tuesday, April 30th ...	" "
54	Carpentry & Joinery—Grade I ...	Monday, April 29th ...	" "
	Do. do. Grade II and	" " ...	" "
	Final (Written)	Saturday, April 27th ...	2.30 to 6.30 p.m.
	Do. Final (Practical)	Saturday, May 18th ...	" "
55	Shipbuilders' work (A. & B.) ...	Wednesday, May 1st ...	7.0 to 10.0 p.m.
	Do. (C.) ...	Tuesday, April 30th ...	" "
56	Boilermakers' work ...	Thursday, May 2nd ...	" "

57	Brickwork (Written) ... ..	Wednesday, May 1st ...	7 to 10.0 p.m.
	Do. (Practical, in London) ...	Saturday, May 18th ...	1.0 to 8.30 p.m.
58	Masonry (Written) ... ..	Monday, April 29th ...	7.0 to 10.0 p.m.
	Do. (Practical, in London) ...	Saturday, May 11th ...	1.0 to 8.30 p.m.
59	Plasterers' work ... ..	Tuesday, April 30th ...	7.0 to 10.0 p.m.
60	Painters' and Decorators' work— Grade I	Monday, April 29th ...	" "
	Do. Grade II and Final (Written)		
61	Milling (Flour manufacture) ...	Saturday, May 4th ...	2.30 to 6.30 p.m.
62	Cabinet-making ... ..	Tuesday, April 30th ...	7.0 to 10.0 p.m.
63	Bookbinding (Written) ... ..	" " "	" " "
	Do. (Practical—Finishing)	Saturday, May 4th ...	2.30 to 6.30 p.m.
	Do. do. Forwarding)	Friday, May 10th, and ...	6.0 to 10.0 p.m.
		Saturday, May 11th ...	2.30 to 6.30 p.m.
68	Basketwork (Written and Practical)	Saturday, May 4th ...	" "
69	Builders' Quantities... ..	Tuesday, April 30th ...	7.0 to 10.0 p.m.
70	Wheelwrights' work ... ..	Thursday, May 2nd ...	" "
71	Leather Dyeing ... ..	Tuesday, April 30th ...	" "
72	Principles of Art in Pattern designing	Saturday, May 18th ...	2.30 to 6.30 p.m.
73	Tailors' Cutting (Written)... ..	Monday, April 29th ...	7.0 to 10.0 p.m.
	Do. Grade I (Practical)	Saturday, May 11th ...	2.30 to 5.30 p.m.
	Do. Final (Practical)	Saturday, May 18th ...	2.30 to 7.0 p.m.
74	Motor Car Engineering—Grade I and Final (Written)	Monday, April 29th ...	7.0 to 10.0 p.m.
	Do. do. Grade II and Final (Design)	Wednesday, May 1st ...	" "
76	Engraving for Calico Printers ...	Thursday, May 2nd ...	" "
77	Engineers' Quantities and Esti- mating	Wednesday, May 1st ...	" "
78	Structural Engineering ... ..	Monday, April 29th ...	" "
79	Heating and Ventilation ... ..	Wednesday, May 1st ...	" "

## EXAMINATIONS FOR WOMEN.

64	Dressmaking (Written) ... ..	Thursday, May 2nd ...	7.0 to 10.0 p.m.
	Do. (Practical) ... ..	Saturday, May 11th ...	2.30 to 7.0 p.m.
65	Millinery (Written) ... ..	Tuesday, April 30th ...	7.0 to 10.0 p.m.
	Do. (Practical) ... ..	Saturday, May 18th ...	2.30 to 6.30 p.m.
66	Plain Needlework (Written) ...	Wednesday, May 1st ...	7.0 to 10.0 p.m.
	Do. (Practical) ... ..	Saturday, May 4th ...	2.30 to 6.30 p.m.
67	Plain Cookery (Written) ... ..	Monday, April 29th ...	7.0 to 10.0 p.m.
	Do. (Practical) ... ..	Saturday, April 27th ...	4.0 to 7.0 p.m.
75	Embroidery (Written) ... ..	Thursday, May 2nd ...	7.0 to 10.0 p.m.
	Do. (Practical) ... ..	Saturday, May 18th ...	2.30 to 7.30 p.m.

# EXAMINATIONS FOR TEACHERS' CERTIFICATES,

1912.

## MANUAL TRAINING.

Wood-work—First Year, Schemes A & B (Practical) <i>Saturday, May 4th</i>			10.0 to 2.0 or 2.0 to 6.0 p.m.
Do.	do.	Schemes A & B (Drawing) <i>Wednesday, May 8th</i>	7.0 to 10.0 p.m.
Do.	do.	Scheme B (Literary Test) <i>Thursday, May 9th</i>	7.0 to 8.30 p.m.
Do.	Final (Drawing) A & B	<i>Wednesday, May 8th</i>	7.0 to 10.0 p.m.
Do.	do.	(Written) <i>Thursday, May 9th</i>	... 6.0 to 10.0 p.m.
Do.	do.	(Practical) <i>Saturday, May 11th</i>	... { 10.0 to 2.0 or 2.0 to 6.0 p.m.
Metal-work—First Year (Written) <i>Thursday, May 9th</i>			... 7.0 to 10.0 p.m.
Do.	do.	(Drawing) <i>Wednesday, May 8th</i>	... " "
Do.	do.	(Practical) <i>Saturday, May 11th</i>	10.0 to 2.0 or 2.0 to 6.0 p.m.
Do.	Final (Practical)	<i>Friday, May 3rd, and Saturday, May 4th.</i>	10.0 to 2.0 or 2.0 to 6.0 p.m. each day.
Do.	do.	(Drawing) <i>Wednesday, May 8th</i>	... 7.0 to 10.0 p.m.
Do.	do.	(Written) <i>Thursday, May 9th</i>	... 6.0 to 10.0 p.m.

## DOMESTIC SUBJECTS.

Blackboard Drawing, <i>Monday, July 1st</i> ... ..			commencing at 10 a.m.
Plain Needlework (Written) <i>Tuesday, July 2nd</i> ...			10.30 a.m. to 1.0 p.m.
Do.	(Practical)	" "	... 2.0 to 6.0 p.m.
Dressmaking (Written) <i>Wednesday, July 3rd</i> ...			10.30 a.m. to 1.0 p.m.
Do.	(Practical)	" "	... 2.0 to 6.0 p.m.
Millinery (Written) <i>Thursday, July 4th</i> ...			10.30 a.m. to 1.0 p.m.
Do.	(Practical)	" "	... 2.0 to 6.0 p.m.
Methods of Teaching, <i>Friday, July 5th</i> ...			... 2.0 to 4.0 or 2.0 to 5.0 p.m.

# SUBJECTS OF EXAMINATION.

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## 1.—SALT MANUFACTURE.

I. Syllabus.—The Examination will include questions founded on such subjects as the following :—

1. The geographical and geological occurrence of salt and similar deposits.

2. The elementary mineralogical relations and chemical composition of the chief commercially important saline deposits existing in the Earth's crust.

3. The elementary chemico-physical phenomena of heat applied to water and aqueous solutions, as, for example, latent heat of water and steam, evaporation, ebullition, vapour tension, solution and crystallisation.

4. The processes employed, and their economic aspects, in the manufacture of salt from the crude material or mineral. Construction of apparatus and machinery employed.

5. Economic advantages or disadvantages of various forms of apparatus and plant for solution and evaporation purposes, taking into account economy of fuel.

6. The relation of the physical condition of the various forms under which salt appears as a raw material or marketable product to the specific uses to which it is put, involving in elementary outline an acquaintance with the principles of the Leblanc (especially the salt-cake branch) and the ammonia-soda processes, and of soap manufacture.

7. The occurrence of bromides and iodides and the manufacture of bromine and iodine from the materials containing them.

*Since the answers in certain cases must be illustrated by sketches, facility in the rapid sketching of plant and apparatus in plan, vertical and horizontal sections, should be acquired.*

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The Examination in Grade I and the Final Examination will be held on Wednesday, May 1st, 7—10 p.m., provided a sufficient number of Candidates present themselves (see Rule 18). The fee for the Examination in either grade is *One Shilling*.

II. Full Technological Certificate.—For the Full Technological Certificate, the Candidate must qualify as stated in Rules 29 and 30.

**III. Works of Reference :—**Roscoe and Schorlemmer "Treatise on Chemistry" (Inorganic portion); Dr. Lunge's "Treatise on the Alkali Manufacture;" Richardson and Watts' "Chemical Technology;" "The Journal of the Society of Chemical Industry;" Muspratt's, Ure's, and Spon's Dictionaries, Article on Salt; Wagner's "Jahresbericht."

## 2.—ALKALI MANUFACTURE.

**I. Syllabus.**—The Examination will include questions founded on such subjects as the following :—

### GRADE I.

1. The principle, construction, and use of the hydrometer, and the conversion of the various scales of Baumé and Twaddell.

2. The employment of specific gravity tables with corresponding percentage strengths, in making calculations of quantities, &c., involved in the sulphuric acid process, as well as in the other branches of Alkali manufacture.

3. The action of sulphuric acid and hydrochloric acid on certain metals, especially on the different varieties of commercial iron and lead. The composition of "chemical lead," &c.

4. The geographical and geological occurrence of sulphur as brimstone and pyrites, of nitrate of soda, common salt, "Muriates" (crude potassium chloride), manganese peroxide, &c.; their chemical composition and the influence of the physical properties of the mineral, and (in the case of salt) also of the prepared forms, on the processes in which these raw materials are employed.

5. The plant and apparatus for the making of nitric acid.

6. Complete plant and apparatus for the making of sulphuric acid from (a) sulphuretted hydrogen gas, (b) brimstone, (c) pyrites, and (d) pyrites smalls, &c.

7. The chemical technology and economy of the entire sulphuric acid process, including calculations.

8. The treatment of the burnt ores, and the recovery of copper and silver in the wet process.

9. The salt-cake process, including the various forms of plant and apparatus now in use.

10. The condensation of hydrochloric acid, plant and process.

11. The blackash process, in hand-worked and revolving furnaces.

12. Lixiviation process, including the construction, arrangement, and working of the vats. Methods of treating Alkali waste for the recovery of the sulphur.

13. The manufacture of strong caustic ash, refined carbonated ash, monohydrate salts, soda crystals and bicarbonate, with construction and arrangement of plant and apparatus.

14. The causticising process. Plant and process for the manufacture of high strength caustic for the manufacture of dyes, certain fine soaps, &c., 70 and 60 per cent. caustic, including calculations of salt to be used in reduction to these strengths, and cream caustic soda.

15. Caustic potash and potassium salts from "Muriates" (crude chloride), and from pearl-ash, &c. Sources and chemical composition of these raw materials. A general acquaintance with the chemical theory of the caustic soda and potash processes will be assumed, and this indeed applies to all the processes named. Questions will be set in the chief methods of testing the values of the principal materials and products. Questions involving chemical technological calculations will be introduced into the papers.

16. The manufacture of bleaching-powder, and liquor, and chlorate of potash, involving the Deacon and Weldon processes and theories. Plant and apparatus employed.

17. The ammonia-soda process; its development and present position, theoretical and practical. The plant, apparatus, and modes of manufacture.

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#### FINAL EXAMINATION.

In the Final Examination more difficult questions will be set in the above subjects, and, in addition, a knowledge will be required of:—

1. The chief methods of testing for impurities, and of estimating the value of the materials and products, and of testing exit-flues and chimneys.

2. The general rules to be observed as to arrangement and proportion of plant, &c., in the grafting on to the Alkali branch proper of other allied branches, such as soap manufacture, glass-making, chlorate of potash manufacture, &c.

3. The various sources of ammonia and chief methods proposed for obtaining it. Manufacture of ammonia and its salts from crude ammoniacal liquor.

4. The application of electricity to the production of Alkali by the electrolysis of the chlorides of potassium and sodium.

*Since the answers in certain cases must be illustrated by sketches, facility in the rapid sketching of plant and apparatus, in plan and vertical and horizontal sections, should be acquired.*

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The Examination in both Grades will be held on **Wednesday, May 1st, 7–10 p.m.** The fee for the Examination in either Grade is *One Shilling*.

**II. Full Technological Certificate.**—For the Full Technological Certificate, the Candidate must qualify as stated in Rules 29 and 30.

**III. Works of Reference.**—Roscoe and Schorlemmer's "Treatise on Chemistry" (Inorganic portion). "The Manufacture of Sulphuric Acid and Alkali," by Lunge (Gurney & Jackson). "Manual of the Alkali Trade," J. Lomas (Crosby Lockwood & Son, London). "Journal of the Society of Chemical Industry." Lunge's "Technical Chemist's Handbook" (Gurney & Jackson, London). Lunge's "Coal Tar and Ammonia." Richardson & Watts' "Chemical Technology." Lunge's "Technical Methods of Chemical Analysis," Vol. I. (Gurney and Jackson, London).

### 3.—SOAP MANUFACTURE.

**I. Syllabus.**—The Examination will include questions founded on the following subjects :—

#### GRADE I.

1. The various processes for clarifying, rendering, and other preliminary treatments of raw fats and oils; theory of the action of different bleaching agents; the best methods of applying the same, and their relative advantages.

2. Nature and preparation of "soap stock fatty acids." Deglycerinised fatty material. Fatty acids from waste fats. Naphthenic acid soaps.

3. Chemical and physical tests for the purity, or otherwise, of fatty matters used in soap-making.

4. The general theory of the process of saponification, including especially the chemical composition and properties of the various fats and fatty acids employed.

5. The various methods of soap-making from neutral fats and fatty acids. Boiling by steam (close or dry, open or wet, or superheated) and by fire. The relative advantages of these methods in particular cases.

6. The materials and processes necessary for the production of—

(a) Household soaps—1. Yellow. 2. Curd, and genuine mottled. 3. Blue, grey, or red mottled.

(b) Toilet soaps of various kinds. Medicated soaps. Transparent soaps.

(c) Soaps for various manufacturing purposes, especially those used in the Textile Industries.

(d) Soft soaps.



(e) Soap powders (dry soaps).

(f) Dry-cleaning soaps.

7. Soaps made by processes other than boiling in open pans ; their merits and demerits. "Cold" soaps. Soap-making by double decomposition.

8. The manufacture and use of alkaline silicates, and of other substances incorporated with soap for specific purposes.

9. Machinery employed in incorporating such substances with soap.

10. Methods of cooling soap paste. Soap cooling machines.

11. Utilisation of by-products of the soap manufacture. Preparation of glycerin.

12. Method of calculating the cost of a soap to be produced.

13. Determination of fatty acids, combined alkali, and free alkali in a finished soap.

14. Determination of glycerol, salt, &c., in crude soap-lye glycerin.

#### FINAL EXAMINATION.

In the Final Examination more difficult questions will be set in the above subjects, and, in addition, a knowledge will be required of :—

1. The preparation of caustic soda lye from (a) soda-ash (or solid caustic), (b) salt cake (*i.e.*, sodium sulphate), and of caustic potash lye from pearl-ash, &c. Questions in the Final Examination under this head will include some of the subjects referred to under Alkali Manufacture, especially paragraphs 1 and 2, and 11 to 15 inclusive ; the method of testing for impurities in the lyes used, as well as the effect of these impurities in the soap-pan at various stages of manufacture and on the finished soap.

2. The design and construction of apparatus, and machinery employed in soap works ; the best arrangement of it in a new factory, and the amount of plant necessary for the production of a given quantity of soap in a specified time.

3. Soap drying installations ; soap cooling machines.

4. Theories on the constitution of soap.

5. The methods employed in analysing soap and determining the proportions of fatty acids, rosin acids, unsaponifiable matter, and alkali in its various forms as combined alkali, free caustic alkali, &c.

6. The examination of the "soap stock" in a given soap.

7. Valuation of soap from the consumers' point of view (*i.e.*, the value of a soap for cleansing purposes).

8. Bleaching of soap in the pasty state.

The Examination in both Grades will be held on Wednesday, May 1st, 7—10 p.m. The fee for the Examination in either Grade is *One Shilling*.

**II. Full Technological Certificate.**—For the full Technological Certificate, the Candidate must qualify as stated in Rules 29 and 30.

**III. Works of Reference.**—R. S. Christiani, "Soap, Candles, &c. (Philadelphia and London), 1881; H. Dussauce, "Manufacture of Soaps" (Philadelphia and London), 1869; "Soap, Candles, Lubricants, and Glycerine," by Carpenter and Leask (Spon and Co., 1885); "The Manufacture of Toilet Soaps," by Dr. C. R. A. Wright (Cantor Lectures, Society of Arts, 1885); "The Art of Soap-making," by Alex. Watt (Crosby Lockwood & Son, London); "Laboratory Companion to Fats and Oils Industries," by J. Lewkowitsch (Macmillan, 1901); "Chemical Technology and Analysis of Oils, Fats and Waxes," by Dr. J. Lewkowitsch (Macmillan, 1909); "Oils and Fats, their Uses and Applications," by Dr. J. Lewkowitsch (Cantor Lectures, Society of Arts, 1904). Current chemical and trade periodicals, especially the Journal of the Society of Chemical Industry. (See also Works of Reference, under Subject 10.)

#### 4.—BREAD-MAKING AND FLOUR CONFECTIONERY.

The object of technical instruction in these subjects is to diffuse a knowledge of the principles which underlie the practice of the trades, and of the practical application of those principles. It is assumed that those who attend the Classes will have acquired such knowledge and practical experience of their trade as may, and should, be gained by work in a well equipped Bakery. But more than this is required, and the attention of students should therefore be directed toward the attainment of such scientific and other knowledge as may help them to master the theory of the subject, and its correct and wider application to practice.

In Grade I. of the following Syllabus, the standard is such as ought to be aimed at by journeymen and forehands. The standard of the Final Examination is higher, and is suited to those who desire to make themselves competent to undertake the management and direction of first-class bread-factories, bakeries, and confectionery establishments, carrying on either wholesale or retail trades.

In the questions set for Examination, careful consideration will be given to the educational status of the Baker or Confectioner and to the extent of his opportunities of study.

The list of text-books appended to the Syllabus is intended as a guide only to the students' work but Final students in particular should keep themselves acquainted with the latest developments of their trade, and particularly with the several important subjects discussed in Trade Journals, or brought to notice at the various Trade Exhibitions.

The Examinations in Bread-making and Confectionery will be distinct, and will be held at different times.

N.B.—The examinations in these subjects are conducted by the Institute, in co-operation with the National Association of Master Bakers and Confectioners.

A free studentship of the value of £25, tenable at the National Association's School, Borough Polytechnic, London, will be given by the Netherlands Yeast and Spirit Factory to the candidate who, not being over 25 years of age, obtains the highest number of marks at the examination in Grade I of Bread-making.

I. Syllabus.—The Examination in both grades will consist of a Written and a Practical Examination.

#### GRADE I.

(1.) Written Examination.—The Examinations will be founded on such subjects as the following :—

##### *General Section.—Common to both Subjects.*

1. Elementary principles of Chemistry and Heat underlying Bread-making and Confectionery.

2. Chemical composition of wheat and flour.

3. Nature of alcoholic and other varieties of fermentation, and their relation to yeast and other varieties of minute organisms. Action of salt on fermentation. Use of thermometers. Effects generally of variations of temperature on fermentation.

4. Properties of aerating agents, bi-carbonate of soda, tartaric acid, cream of tartar, &c. Nature and control of chemical changes which cause these to evolve gas.

5. Use of the microscope, and its application to the examination of flour and yeast for impurities, adulteration, and general qualities.

#### A.—BREAD-MAKING.

Practical Bakehouse Work. Respective behaviours of different varieties of yeast during fermentation. Details of whole process of preparing ferments. Sponging and doughing—varieties of flour used, best times and temperatures with different yeasts. Bakehouse calculations, as for example, quantities of flour, water and other materials

required for making a given amount of bread. Calculation of temperature of doughs from those of flour and water used, &c. Method of using the thermometer for accurately ascertaining temperature of flour, water, and dough. Scaling, moulding, and proving of loaves. Method of cleaning, firing, manipulation, and filling of oven. Changes produced during baking by heat. Cooling and storing of bread. Utensils of a bakehouse; how to keep them clean, and their general arrangement and management.

### B.—CONFECTIONERY.

1. Confectioners' Raw Materials. Goods for which the different methods of aerating are specially adapted. Substances used for moistening: water; milk, separated and skim milk, sour milk and butter milk; eggs; properties and effects of each. Enriching or "shortening" agents: butter, lard; properties and general characters. Sweetening agents: different varieties and qualities of sugar, syrup or treacle; effects produced by each beyond that of simply sweetening goods. Fruit, different kinds: currants, peels, preserved fruits or jams. Cost of raw material. Estimated profits on mixtures, &c.

2. Confectioners' vessels and utensils. Bowls and mixing vessels, hand and machine whisks. Cutters. Ovens, varieties of and temperature most suitable for different goods.

3. Recipes and methods of manufacture of such goods as :—

*Fermented Goods*—Plain, Bath, and Chelsea buns. *Paste Goods*—Puff paste, short paste, how to prepare; tartlets, Eccles cakes, Congress tarts. *Sponge Goods*—Sponge cakes, Swiss roll, fingers. *Small Cakes*—(Hoop or tin cakes) Madeira, pound, luncheon cakes, rock and rice cakes, queen's scones, and goods generally known by Flour Confectioners as counter goods.

(2.) **Practical Examination.**—Candidates either in Bread-making or Confectionery are required to present themselves for the Practical Test. This examination will probably be held at the National School of Bakery and Confectionery, Borough Polytechnic, London, at Belfast, Birmingham, Bristol, Cardiff, Leeds, Liverpool, Manchester, and Wigan, possibly at other centres, provided the necessary arrangements can be made and a sufficient number of Candidates present themselves at each of these centres.

The examination will be held in a Bakehouse either in a school or elsewhere.

### A.—BREAD-MAKING.

Each Candidate will be provided with a given quantity of flour (about 14 lbs.), and yeast, salt, &c., in quantities at his own option, and will be expected to make and bake a small batch of household bread, Vienna rolls, and wholemeal bread.

The Examiners will report on the manner in which the Candidates have set about their work and have conducted the operation, having regard to cleanliness, tidiness and general attention to details.

Candidates will be allowed some time between 4 and 6 hours for the Examination, but the batch or plain bread must be made by a process the length of which will be fixed for each centre by the Institute's Examiners present, and will be announced to the Candidates at the commencement of the Examination.

The Candidates at any one centre may be divided into groups and required to use methods extending over different times.

Where one of the Chief Examiners is unable to be present at the Practical Test a sample of each Candidate's work must be sent to London for inspection by the Chief Examiners.

### B.—CONFECTIONERY.

Each Candidate will be required to make five articles selected by the Examiners on the day on which the Examination is held, from those mentioned above in Section B. 3.

All absolutely necessary utensils and ingredients will be provided; but Candidates are at liberty to bring with them any tools they may desire. The Examiners will be guided in their awards by the quality of the finished articles, and will also attach great importance to the workmanlike manner in which the Candidate executes the practical test.

A. Bread-Making—The Written Examination (Grade I) will be held on Tuesday, April 30th, 7 to 10, the Practical on dates to be subsequently fixed for each centre.

B. Confectionery—The Written Examination will be held on Wednesday, May 1st, 7 to 10, and the Practical on dates to be subsequently fixed for each centre.

The fee for the entire Examination (Written and Practical) in either subject is *Two Shillings and Sixpence*.

### FINAL EXAMINATION.

*Candidates for the Final Examination will be required to have previously passed in Grade I.*

#### A.—BREAD-MAKING.

(1.) Written Examination.—In the Written Examination more difficult questions will be set in the subjects of Grade I. and, in addition, a knowledge will be required of :—

1. Flour. Leading characteristics of straight-grade flours from the more important single wheats. Relative merits of flours from single wheats and mixtures. Relative merits of straight-grade, bakers', and patent flours. Flour testing and valuation. Determination of moisture, gluten, colour, water-absorbing power, and consequent bread-yield. Detection of adulteration and impurities.

Methods of buying flour and valuing same against sample, fair average quality of season's shipments, or miller's standard for particular brand. Best bakehouse testing routine in order to ensure satisfactory quality of flour delivered. *The student's knowledge in this section will be tested by a separate practical examination.*

2. More detailed knowledge of the constituents of flour and their effect on each other during fermentation. Constitution of starch and nature of the changes it undergoes in conversion into alcohol during saccharification and fermentation. Composition of gluten, effect on the character of the flour of different proportions of gliadin and glutenin. Nature and properties of various diastases, malt diastase, raw flour diastase, "artificial" diastase. Effect of use in bread-making of malt extracts and other diastasic preparations. Best methods of testing same.

3. Yeasts. Microscopic appearance of healthy and unhealthy cells. Detection of foreign ferments and adulteration. Determination of gas-evolving power, or strength of various yeasts. Theory and practice of patent yeast manufacture. Ferments and leavens; their effect on bread, and merits and demerits. Changes occurring in dough during fermentation. Prevention of occurrence of sour and ropy bread, and remedies for the same.

4. Various Bread-making methods. Full details of quantities, times and temperatures. Long and short processes of fermentation, relative advantages and disadvantages of each, more especially from the economic and the labour point of view. Special breads and bread-making processes. Fancy breads. Whole-meal, Vienna, and other breads. Methods of aerating bread other than by yeast. Comparison of these with the fermentation process.

5. Bread-making Machinery. Flour blending and sifting machinery; sponge-stirring, dough-making, and dough-dividing machines. Their principles, use, and manipulation. Sources of power. Steam, gas and oil engines, how to start, work, and keep in order. Belting and gearing, simple laws governing speed of pulleys, &c. Water tempering and measuring tanks.

6. Baking. Construction of various types of oven. Relative advantages and modes of manipulation. Use and theory of steam-jet for glazing.

7. Practical bakehouse management. Best situation for a bakery; ventilation, drainage, and sanitary arrangements. Internal fitting and arrangements; number of ovens, machines, troughs and other utensils necessary for a trade of any given dimensions. Best mode of arrangement, and space that would be required. Number of men necessary, distribution of duties, and hours of commencing and leaving work. Modes of checking quantity of flour used and bread produced. Factory Acts in their relation to bakers, conditions required for safety of machinery and efficient sanitation.

(2.) **Practical Examination.**—Candidates will be required to present themselves for a Practical Examination on Flour Testing.

Samples will be forwarded, which they will be required to examine :—

1. For gluten and water-absorbing power.
2. For percentage of water contained in the flour.
3. By means of a baking test, reporting fully on the general quality and behaviour of the flour.
4. For bleaching by oxide of nitrogen reagents.
5. For adulteration with flour from other cereals, and alum.

The written Examination will be held on Tuesday, April 30th, from 7 to 10 p.m.

The Practical Examination will be held on dates to be subsequently fixed. Candidates may be required to provide themselves with the apparatus necessary for these tests, if no other arrangements can be made. The use of Text-books on Analysis and Flour Testing is permitted.

The fee for the entire Examination is *Two Shillings and Sixpence*.

#### B.—CONFECTIONERY.

(1.) **Written Examination.**—More difficult questions will be set in the subjects of Grade I, and in addition knowledge will be required of other subjects, such as the following :—

1. Confectioners' Raw Materials. Aërating agents: acid phosphates and sulphates, cream of tartar substitutes, ammonium carbonate or "volatile." Properties of condensed milk and goods for which suitable. Different kinds of butter, tough and otherwise, and goods for which suited. Butter substitutes, margarines and other substances, general characters and uses. Principal animal and vegetable fats used in the preparation of such substitutes. Sweetening agents: malt extracts, glucose, glycerine, saccharin; goods for which each is specially indicated. Nuts: almonds, pistachio nuts, &c., for what and how used.

Essential oils and flavourings; essential oils of lemon, orange, and almonds, principal spice oils. Flower and fruit essences; orange flower water, vanilla, &c. Colouring matters, egg and cake colours, principles of mixing; classification into harmless and injurious varieties.

Impurities and adulterants of raw materials; simple methods of valuing and testing same for impurities and adulteration. Current prices of raw materials. Percentage of profits on different mixings.

2. Laws of decorative art as applied to Confectionery; form, colour, harmonies, contrasts.

3. Confectioners' machinery; fruit cleaning, almond grinding, whisking, cake making, and other machines.

4. Recipes and methods of manufacture of such goods as :—

*Fermented Goods.*—Savarins, babas, dough cakes. *Paste Goods.*—Maids of honour, vol-au-vent cases. Pies, custards, &c. *Small*

*Cakes.*—Tennis, Russian, simnel. *Slab Cakes.*—Rich and cheaper varieties of Genoa and other cakes. *Ornamental Piping.* *Confectioners' Biscuits.*—Macaroons, routs, Parisiennes. *Fondant Making.* *Flavouring and Colouring.* *Afternoon Fancies and Petits Fours Glacés.* Goods generally sold by high class Flour Confectioners.

(2.) *Practical Examination.*—This will be similar to that for Grade I, but the goods to be made may be selected from the list given for Grade I, as well as from that given above (paragraph 4).

The *Written Examination* will be held on *Wednesday, May 1st*, from 7 to 10. The *Practical Examination* will be held on dates to be subsequently fixed.

The fee for the entire Examination (*Written and Practical*) is *Two Shillings and Sixpence*.

**II. Full Technological Certificate.**—For the Full Technological Certificate, the Candidate will be required to qualify as stated in Rules 29 and 30.

**III. Works of Reference.**—Milling and Baking Trade Journals; "Flour-Testing Tables," by Thoms; "The Science and Art of Bread-making," by Jago, (Simpkin, Marshall & Co.). "Introduction to the Study of Bread-making," by Jago, (Maclaren & Sons, Glasgow.). Cantor Lectures on "Modern Development of Bread-making," by Jago, (Society of Arts.). "Dietetic Value of Bread," by Goodfellow, (Macmillan.). *Elementary Principles of Bread-making*, by Goodfellow, and "Practical Bread-making," by Vine (61 and 62, Chancery Lane, W.C.). "The Baker's Guide," by John Blandy. "The Art of Confectionery," by George Cox (Nat. Assoc.); 2nd Edition. "The Bakery World," by Blandy (190, Fleet Street).

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## 5.—BREWING.

**I. Syllabus.**—The Examination will include questions founded on such subjects as the following :—

### GRADE I.

1. Preparation and properties of cellulose, starch from various sources, soluble starch, dextrose, cane and invert-sugar, and the products of the hydrolysis of starch.
2. The examination and valuation of barleys from various districts. Kiln-drying barleys, storing and screening.
3. Malting. The process of malting, including the so-called atmospheric systems. Buildings, plant, and machinery employed. Conditions necessary for healthy germination.
4. The examination and comparative valuation of malts. Estimation of extract, proteins, ash constituents, &c.



5. Water. Analytical examination and test of fitness for brewing ales and stouts. Artificial softening and purification. Fitness for use in steam boilers.

6. Arrangement of buildings, plant, and machinery in a brewery.

7. Mashing. Various methods of making the mash. Use of raw grain and other starch-containing material. Chemical changes effected during the mashing process, especially those attending the hydrolysis of starch. Influence of time and temperature on the result.

8. Use of sugar as a brewing material.

9. Boiling. Influence of boiling on the raw wort. Objects attained by the use of hops. Examination and valuation of hops. The true nature of the so-called hop "flowers," and the properties of their chief chemical constituents. Sulphured hops and their detection. The cold storage of hops.

10. Cooling. Various forms of coolers and refrigerators. Influence of aëration on the cooling worts.

11. The various forms of the *Saccharometer*, and the relation of their readings to each other and to specific gravity as ordinarily indicated.

12. Excise duty on beer. Calculation of duty chargeable on worts. Excise regulations affecting breweries. "Drawback" on exported beer.

13. Fermentation. The various systems of Fermentation employed in the United Kingdom. The yeast organisms. Microscopical examinations of ferments, their modes of growth and reproduction. The chemical function of the ferments. Theories of fermentation.

14. Analysis of beer and worts. Determination of "original gravity." The "forcing tray" process as a test of the stability of a beer.

15. Preservative agents, and how applied to beer. The preparation and use of finings and caramel.

16. Storing, bottling, and management of beer in the cellar.

### FINAL EXAMINATION.

In the Final Examination more difficult questions will be set in the above subjects, and, in addition, a knowledge will be required of :—

1. The morphology and embryology of the barley grain, and its structural relations to the grain of other cereals.

2. The chemical and morphological changes produced in the grain by the malting process.

3. The processes employed for the production of lager beer. The decoction mash and "low" fermentation. The "Vacuum" system.

4. The isolation of ferments and their cultivation in a pure state by the methods of Koch, Hansen, &c.

5. A knowledge will also be required of the more important original investigations of the last few years bearing upon the chemistry and bacteriology of the brewing processes.

6. The use of the polariscope.

7. The market value of the principal brewing materials.

8. The treatment and disposal of brewery waste products.

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The Examination will be held in both grades on Wednesday, May 1st, 7 to 10 p.m. The fee for the Examination in either Grade is *One Shilling*.

**II. Full Technological Certificate.**—For the Full Technological Certificate, the Candidate must qualify as stated in Rules 29 and 30.

**Works of Reference.**—"The Science of Brewing," by Moritz and Morris (Spon); "Practical Brewing," by E. R. Southby; "Manual of Alcoholic Fermentation," by C. G. Matthews (Arnold, 1901); "A Handy Book for Brewers," H. E. Wright (Crosby Lockwood & Son) 1897; "Laboratory Text Book for Brewers," L. Briant (Fell & Briant) 1898; "Etudes sur la Bière," Pasteur (Paris), (also an English translation by Faulkner & Robb); "Micro-organisms and Fermentation," Jörgensen; "The Microscope in the Brewery," by Matthews & Lott (Bemrose); "The Principles and Practice of Brewing," W. J. Sykes and A. R. Ling (Griffin); "Handbuch der Kohlenhydrate," B. Tollens (Trewendt, Breslau); "Chemie und Physiologie des Malzes und des Bieres," E. Pryor (Barth, Leipzig); "Practical Studies in Fermentation," E. C. Hansen (translated by A. K. Miller, Spon) 1896; "La Pratique du Maltage," L. Levy (Carré, Paris); "The Soluble Ferments and Fermentation," Reynolds Green (Cambridge University Press) 1899; "The Handbook of the Polariscope," Landolt (translated by Robb & Veley, Macmillan); "Transactions of the Federated Institutes of Brewing"; "Experimental Methods Employed in the Examination of the Products of Starch Hydrolysis by Diastase," Brown, Morris & Miller (Journal of the Chemical Society), 1897; "Fermentation Organisms," Klöcker (Longmans); "Practical Management of Pure Yeast," A. Jörgensen (Brewing Trade Review); "Laboratory Studies for Brewing Students," A. J. Brown (Longmans); "The Brewing Industry," Julian L. Baker (Methuen), 1905; "The Nature of Enzyme Action," W. M. Bayliss (Longmans, Green & Co.); "The Hop and its Constituents," edited by A. C. Chapman (The Brewing Trade Review); "Commercial Organic Analysis," edited by Leffmann and Davis, 1909 (T. A. Churchill); "Das chemische Laboratorium des Brauers," 1902.

A short sketch of the anatomy of the barley-grain will be found in the Presidential Address for 1888 to the Burton-on-Trent

Natural History Society, by Horace T. Brown. (See Transactions of the Society for 1889.) Advanced students may also consult the large work of Lermer and Holzner, "Beiträge zur Kenntniss der Gerste," Munich, 1888, and papers on Germination, by H. Brown and Morris, Journal of the Chemical Society, 1890, and H. Brown and Escombe, Proceedings of the Royal Society, 1898.

## 6.—SPIRIT MANUFACTURE AND RECTIFICATION.

**I. Syllabus.**—The course of instruction is intended to cover a period of at least two years. The Examination will include questions founded on such subjects as the following:—

### GRADE I.

1. The chief chemical and physical properties of:—Starch, cellulose (and their products of hydrolysis); cane sugar, maltose, dextrose, and lævulose; their identification and estimation.

2. The examination and valuation of the various cereals used in the manufacture of spirit.

3. Processes of preparing Distillers' Malt, including the so-called pneumatic systems. The examination and valuation of malt.

4. *Water.*—Analytical examination and tests of fitness for distillery purposes. Artificial softening and purification; fitness for boiler purposes.

5. *Mashing as practised by Distillers.*—Chemical changes effected during the mashing process, especially those attending the hydrolysis of starch. Influence of acids, alkalis, and salts; also of time and temperature on the result. The conversion of starch into sugar by hydrolytic agents, such as sulphuric acid.

6. The composition and character of the various raw sugars and molasses used in the manufacture of spirit. Methods of determining their value.

7. *Distillers' Wort and its Examination.*—Determination of the specific gravity of liquids by various methods and the principles underlying them. The saccharometer.

8. *Alcoholic Fermentation.*—Nature of yeast (*Saccharomyces cerevisiæ*, &c.); its microscopical appearance. Influence of temperature, oxygen, nitrogenous matters (mineral and organic), acids, alkalis, and salts on the development of yeast and its power to incite alcoholic fermentation.

9. *Temperature and its Measurements.*—Heat units. Specific heat. Latent heat of vapours.

10. *Determination of Boiling Points.*—Influence of pressure on boiling point. Vapour tension of water, alcohol, &c., numerically and graphically expressed. Pressure regulators.

11. The principles of fractional distillation. The Coffey still. Rectification of spirit; various forms of rectifying columns.

12. Analysis of mixtures of two liquids by observation of their specific gravity.

13. The chief chemical and physical properties of alcohol and its related compounds. The oxidation of alcohol and the conditions under which it occurs. The so-called higher alcohols. The constituents of fusel oil.

14. The various bye-products of alcoholic fermentation; their probable origin, uses, &c. The removal of those which occur in commercial alcohol. Filtration of spirit through charcoal.

15. Arrangements of buildings, plant, and machinery in a distillery.

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### FINAL EXAMINATION.

In the Final Examination more difficult questions will be set in the above subjects, and, in addition, a knowledge will be required of:—

1. The polarimeter and its uses in the investigation of the carbo-hydrates. The researches of Pasteur, van 't Hoff, and Le Bel on the constitution of compounds which are optically active in solution. The researches of Emil Fischer and others on the sugars and their derivatives.

2. The principal chemical and physiological changes which raw cereals undergo during their conversion into malt. Diastase, and the enzymes of malt.

3. The isolation and cultivation in a pure state of yeasts and other organisms by the methods of Koch, Hansen, &c.

4. The specific action of the enzymes of yeast and other organisms. The recent researches of Buchner and others on alcoholic fermentation.

5. The occurrence of diastatic ferments in certain yeasts and mould fungi, and the possibility of producing alcohol from starch in a single operation.

6. Calculation of the calorific power of coal, and of the amount required to raise steam, and evaporate different liquids.

7. Calculation of the amount of water (at a given temperature) requisite for condensing different vapours.

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The Examination in both Grades will be held on Wednesday, May 1st, from 7 to 10 p.m. The fee for the Examination in either Grade is *One Shilling*.

II. Full Technological Certificate.—For the Full Technological Certificate, the candidate must qualify as stated in Rules 29 and 30.

III. Works of Reference :—H. Watts, " Dictionary of Chemistry "

(Second Edition, edited by Morley and Muir). T. E. Thorpe, "Dictionary of Applied Chemistry." Richter, "Chemistry" (Inorganic and Organic), (translated by Smith). Mackenzie, "Dictionary of the Arts and Manufactures." Nettleton, "Manufacture of Spirit." Nettleton, "Condensing and Cooling in Pot-Still and Patent-Still Distillation." Ad. Meyer, "Lehrbuch der Gährungs-chemie." K. Stammer, "Die Branntweinbrennerei." Max Maercker, "Handbuch der Spiritus Fabrikation." Moritz and Morris, "Science of Brewing." Sykes, "Principles and Practice of Brewing." Jörgensen, "Micro-organisms of Fermentation" (Third Edition, translated by Miller and Lennholm). Lafar, "Technical Mycology" (translated by Salter). A. Gordon Salamon, "Cantor Lectures, 1888." Sykes, "Mashing and Fermenting from the Distillers' Point of View" (Trans. Inst. Brewing, 1892). Squire, "The Conversion of Starch into Alcohol" (Journal Soc. Chem. Ind., 1884).

Advanced Students may also consult :—"A Short Sketch of the Anatomy of the Barley-grain," to be found in the Presidential Address to the Burton-on-Trent Natural History Society, by H. T. Brown, 1889. Tollens, "Handbuch der Kohlenhydrate" (2 vols.). E. O. v. Lippmann, "Die Zuckerarten." L. Maquenne, "Les Sucres et leurs principaux Dérivés." P. Lindner, "Mikroskopische Betriebskontrolle in den Gährungsgewerben." C. Oppenheimer, "Ferments and their Actions" (translated by C. A. Mitchell). Pasteur, "Studies on Fermentation" (translated by Faulkner and Robb). J. Heron, "The Polariscope and its Application to Brewing." H. Landolt, "Das Optische Drehungsvermögen" (2te Auflage). W. J. Pope, "Cantor Lectures, 1901." Various scientific papers and abstracts in the Journal of the Chemical Society; The Journal of the Society of Chemical Industry; The Transactions of the Institute of Brewing (last vol., 1894); The Journal of the Federated Institutes of Brewing.

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## 7.—COAL TAR DISTILLATION AND COAL TAR PRODUCTS.

Separate Examinations will be held in A.—Coal Tar Distillation and Intermediate Products; B.—Coal Tar Colouring Matters, &c.

### A.—COAL TAR DISTILLATION AND INTERMEDIATE PRODUCTS.

I. Syllabus.—The examination will include questions founded on such subjects as the following :—

#### GRADE I.

1. The principles of fractional distillation as applied to coal-tar. Working of the tar-still and separation of the more important constituents.

2. Calculations involving the latent heat of vapours, the specific heat of liquids, and the specific gravity of liquids and solids. Works methods for determining specific gravity.

3. Pyrogenic reactions. Composition of coal-tars from various sources and produced under different conditions of coal distillation. Circumstances affecting the composition of tars. Valuation of tars from the point of view of the various industries in which tar products are employed.

4. The direct use of tar and its fractions. Creosote oils for timber preserving, solvent naphthas, hard and soft pitch, asphalte, briquette fuel, lamp-black, &c.

5. Working up the separate fractions of the tar. Treatment of the light oil by chemical and mechanical processes. Fractionating columns and their use.

6. Hydrocarbons of the benzene series and their associated impurities such as thiophene and its homologues. The general chemical characters of these hydrocarbons.

7. Treatment of the middle oil or carbolic oil. The chief constituents of this fraction. Phenol (carbolic acid), its separation, purification and chief uses.

8. Naphthalene, its uses, properties, mode of separation, and purification.

9. Anthracene, its separation, purification and general characters. Valuation of raw anthracene. Nature of the compounds associated with anthracene in the anthracene oil.

10. Treatment and valuation of the ammoniacal liquors from gas works. The preparation and uses of ammonia and its salts. Gas liquor as a source of cyanogen compounds. Processes for the recovery of cyanides from gas liquor.

11. Other tar products of actual or possible utility such as pyridine and related bases, phenanthrene, carbazol and homologues of phenol, &c.

12. The manufacture, properties and chemical characters of some of the more important derivatives of the coal-tar hydrocarbons used in the colour and other organic chemical industries, such as nitrobenzene and aniline, dinitrobenzene, the nitrotoluenes and toluidines, nitronaphthalenes and naphthylamines, the sulphonic acids of coal-tar hydrocarbons, &c.

13. An elementary knowledge of the theory of the chemical constitution of the aromatic hydrocarbons with special reference to benzene and its homologues, naphthalene, anthracene, &c.

The fee for the Examination in Grade I is *One Shilling and Sixpence*. The Examination will be held on *Thursday, May 2nd*, from 7 to 10 p.m.

... .. Examination, &c.

## FINAL EXAMINATION.

*Candidates for the Final Examination must hold a Certificate in Grade I.*

The Examination will be Written and Practical.

(1) **Written Examination.**—In the Final Examination a fuller and more detailed knowledge will be required of the subjects of Grade I, in addition to the following :—

1. The practical conditions of manufacture, general arrangement of plant, recovery or utilization of by-products, &c.

2. Plant used for the condensation of by-products from coke-ovens.

3. Processes for the production of aromatic hydrocarbons from petroleum residues.

4. Details of construction and of mode of working the plant used in the physical and chemical treatment of the various fractions of coal-tar.

5. An advanced knowledge of the theory of the chemical constitution of the aromatic hydrocarbons and their derivatives as given in the Syllabus for Grade I, par. 13, with special reference to the bearing of the theory upon the technical processes for the manufacture of the important raw materials used in the colour industry.

6. Recent research bearing upon the chemistry and technology of coal-tar ; current patent and technical literature.

(2) **Practical Examination.**—The Practical Examination may include :—

1. Determination of physical properties such as boiling-point, melting-point, specific gravity, viscosity and flash-point.

2. Identification of commonly occurring coal-tar constituents. Characterisation by preparation of crystallised specimens of the compounds or their derivatives.

3. Valuation of various mixtures of hydrocarbons, &c., by fractional distillation after chemical treatment for removal of acid and basic constituents.

4. Distinguishing tests for fatty and aromatic hydrocarbons ; nitration test for commercial benzole.

5. Estimation of carbon disulphide and of total sulphur in commercial benzoles for power production.

6. Ammoniacal liquor and spent oxide. Estimation of free and combined ammonia, cyanides and sulphocyanides.

7. Valuation of crude and partly refined carbolic acids.
8. Valuation of raw and washed anthracene for the alizarin industry by the anthraquinone test.
9. Pitch ; estimation of volatile matter and of ash ; determination of softening point and toughness.

The Written Examination will be held on Thursday, May 2nd, from 7 to 10 p.m., and the Practical Test on Saturday, May 4th, from 2.30 to 7.30 p.m., or at other times if found necessary.

The fee for the entire examination, written and practical, is *Five Shillings*.

## B.—COAL TAR COLOURING MATTERS, &C.

I. Syllabus.—The Examination will include questions founded on such subjects as the following :—

### GRADE I.

1. Manufacture of the more important auxiliary organic compounds used in the coal-tar colour industry, such as methyl alcohol, carbonyl chloride, chloracetic acid, formic aldehyde, acetone, &c. Testing and valuation of auxiliary compounds.

2. General chemical operations employed in colour works such as oxidation and reduction, nitration, chlorination, alkylation, sulphonation, diazotisation, &c.

3. The nitro-, haloid-, nitro-haloid, &c., derivatives of the hydrocarbons of the benzene and naphthalene series used in the colour industry. The sulphonic acids of these hydrocarbons and their derivatives.

4. The manufacture of the basic compounds used by the colour maker such as aniline and its homologues, the naphthylamines, &c. The nitro- and sulfo-, &c., derivatives of these bases. Diamines, such as metaphenylene and metatoluylene diamine, &c.

5. Uses of phenol and phenolic compounds, cresols, resorcinol, &c., in the colour industry. Manufacture of nitro-derivatives such as picric acid, &c. The naphthols and their sulphonic acids.

6. Manufacture of intermediate products from bases, phenols, &c. The alkylated and dialkylated anilines and homologues, naphthylamines, &c. Diphenylamine and homologues ; nitroso-derivatives such as nitrosodimethylaniline ; salicylic acid from phenol, &c. Aminophenols and alkylated derivatives.

7. Intermediate products from other sources such as phthalic acid from naphthalene, benzoic aldehyde and benzoic acid from toluene, salicylic aldehyde from phenol, gallic and pyrogallic acids from tannin.



8. The more complex intermediate products obtained from the foregoing: azobenzene and homologues; benzidine and homologues; methoxybenzidine and dianisidine; stilbene derivatives; dehydrothiotoluidine and sulphonic acids.

9. An elementary knowledge of the theory of the chemical constitution of aromatic hydrocarbons as given under Section A, Ordinary Grade, No. 13. Application of the theory to the intermediate products and the simpler types of colouring-matters.

10. The manufacture, properties, and constitution of the most important colouring-matters belonging to the following groups:—

- (a) Nitro colouring-matters.
- (b) Nitroso or quinoneoxime colouring-matters.
- (c) Azo colouring-matters (wool colours, direct cotton colours, mordant azo colours). Formation of azo colours on the fibre.
- (d) Stilbene colouring-matters.
- (e) Di- and triphenylmethane colouring-matters (rosanilines, &c.).
- (f) Xanthene or pyrone colouring-matters (phthaleins, &c.).
- (g) Acridine colouring-matters (phosphine, acridine yellow, &c.).
- (h) Anthracene colouring-matters (alizarines, anthracene blues, &c.).
- (i) Indophenols and indamines.
- (j) Azines and azonium colouring-matters (indulines, safranines, rosindulines, &c.).
- (k) Oxazine colouring-matters (Meldola's blue, gallocyanine, &c.).
- (l) Thiazine colouring-matters (methylene blue, &c.).
- (m) Thiobenzoyl or thiazol colouring-matters (primuline, thioflavine, &c.).
- (n) Quinoline colouring-matters (quinoline yellow, &c.).
- (o) Sulphide colouring-matters (Vidal black, immedial black, &c.).
- (p) Indigo and its derivatives. Indigoid vat dyes of various types.

The fee for the Examination in Grade I is *One Shilling and Sixpence*. The Examination will be held on *Thursday, May 2nd*, from 7 to 10 p.m.

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#### FINAL EXAMINATION.

*Candidates for the Final Examination must hold a Certificate in Grade I.*

The Examination will consist of a Written Examination and a Practical Test.

(1) **Written Examination.**—In the Final Examination a fuller and more detailed knowledge will be required of the subjects of Grade I, in addition to the following :—

1. An advanced knowledge of the benzene theory, its experimental basis and the consideration of the various structural formulæ of aromatic hydrocarbons. The isomerism of benzene, naphthalene and anthracene derivatives and the laws of substitution. The chemical constitution of the colouring-matters. Theories connecting the colour and tinctorial properties of benzene, &c., derivatives with their chemical constitution.

2. Identification of colouring-matters in the solid form or upon the fibre. Detection of mixtures and adulterants. Use of the spectroscope and colorimeter in the dyeworks laboratory.

3. Medicinal products obtained from coal-tar, such as antipyrin, antifebrin, phenacetin, salol, iodol, saccharin, &c.

4. Photographic developers, such as hydroquinone, pyrocatechin, eikonogen, amidol, metol, &c.

5. Perfumes and flavours, such as vanillin, coumarin, artificial musk, &c.

6. The employment of nitro-derivatives of aromatic compounds as explosives.

7. The later developments of the coal-tar colour industry as connected with the progress of scientific research ; current technical and patent literature.

(2) **Practical Examination.**—The Practical Examination may include :—

1. Preparation of dyestuffs or intermediate products. (Marks given for the purity of the product and yield.)

2. Identification of commonly-occurring raw and intermediate coal-tar products. Characterisation by preparation of well crystallised derivatives.

3. Examination and valuation of important materials, such as benzene, toluene, aniline, toluidines, paranitraniline, alpha-naphthol, beta-naphthol, nitrobenzene, nitrotoluenes, dinitrobenzene, benzidine, naphtholsulphonic acids, benzaldehyde, resorcinol, anthracene, &c.

4. Determination of naphtholsulphonic acids and metadiamines by titration with standard diazobenzene chloride solution.

5. Determination of amino-compounds by titration with standard sodium nitrite solution.

6. Identification of dyestuffs in substance or upon the wool or cotton fibre.

7. Determination of the structure of azo-dyestuffs by reduction, and isolation or characterisation of the decomposition products.

8. Estimation of nitrogen, sulphur, halogens, methoxy-groups or acetyl-groups in a given compound.

9. Quantitative estimation of dyestuffs by volumetric analysis.

The Written Examination will be held on Thursday, May 2nd, from 7 to 10 p.m., and the Practical Test on Saturday, May 4th, from 2.30 to 7.30 p.m. or at other times if found necessary.

The fee for the entire Examination, written and practical, is *Five Shillings*.

**II. Full Technological Certificate.**—For the Full Technological Certificate the Candidate will be required to qualify as stated in Rules 29 and 30.

**III. Works of Reference.** — “Distillation of Coal Tar and Ammonia,” by G. Lunge; “Chemistry of Dyestuffs,” by Georgievics; Nietzki’s “Chemistry of the Organic Dyestuffs,” translated by Collin and Richardson; “The Synthetic Dyestuffs,” by Cain and Thorpe; “Survey of the Organic Colouring Matters,” by Arthur G. Green; “A Manual of Dyeing,” by Knecht, Rawson and Löwenthal; “New Reduction Methods in Volumetric Analysis,” by Knecht and Hibbert; “Tables for the identification of colouring matters in dyed fabrics of wool and of cotton,” by A. G. Green; “Die Chemie des Steinkohlentheers,” by G. Schultz; “Die Fabrikation der Theerfarbstoffen und ihrer Rohmaterialien,” by Harmsen; “Die Anilinfarben und ihrer Fabrikation,” by Heumann, Friedländer and Schultz; “Die Technik der Rosanilin-farbstoffen,” by O. Mühlhäuser; “Les Matières Colorantes Artificielles,” by Léon Lefèvre; “Chimie des Matières Colorantes Artificielles,” by Seyewetz and Sisley; “Fortschritte der Theer-farbenfabrikation,” by Friedländer; “Derivate des Naphtalins,” by Täuber and Norman; “Koloristische und Textilchemische Untersuchungen,” by Heermann.

**Periodicals.**—The Journal of the Chemical Society; the Journals of the Society of Chemical Industry and of the Society of Dyers and Colourists, including abstracts of patents in these journals; Zeitschrift für Farben- und Textil-Industrie, edited by A. Buntrock; Revue Générale des Matières Colorantes, edited by L. Lefèvre; Die Berichte der Deutschen Chemischen Gesellschaft.

## 8.—SUGAR MANUFACTURE.

**I. Syllabus.**—The Examination will include questions founded on such subjects as the following :—

### GRADE I.

1. Cane sugar : its occurrence in nature.
2. Methods of extracting the juices of sugar-yielding plants; composition of the juice so extracted.

3. The principal methods of making raw sugar from these juices and the apparatus employed, including the "vacuum pan," "multiple effect pan," and "concretor."

4. Refining of sugar. *Practical* details of melting and bag filtering and boiling in vacuo.

5. Treatment of the boiled mass for the preparation of "loaf sugar," "crystals," and "pieces" (crushed) respectively.

6. Treatment of the syrup to secure the extraction of the last available portions of sugar.

7. Molasses or treacle, composition and nature of.

8. Animal charcoal; its preparation, composition, revivification, and action on cane and beet juice and solutions of raw sugar.

9. The centrifugal machine, general construction of some of the principal forms of—method of using, explanation of its action.

10. Apparatus and machinery in general use in sugar factories and refineries.

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#### FINAL EXAMINATION.

In the Final Examination more difficult questions will be set in the above subjects, and in addition a knowledge will be required of:—

1. Analysis and valuation of raw sugar and syrups, construction and principles of the instruments, and the preparation and standardising of the reagents employed.

2. The chemistry of cane sugar: its composition, properties, and its changes under the action of heat, acids, and ferments.

3. Glucose—its properties and its relation to cane sugar, distinguishing between dextrose and levulose.

4. The chemistry of animal charcoal.

5. The physics of the vacuum pan (involving properties of steam).

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The Examination in both Grades will be held on Tuesday, April 30th, 7 to 10 p.m. The fee for the Examination in either Grade is *One Shilling*.

II. Full Technological Certificate.—For the Full Technological Certificate, the candidate must qualify as stated in Rules 29 and 30.

III. Works of Reference.—"The International Sugar Journal" (Office of the 'Sugar-Cane,' Altrincham, near Manchester); the article "Sugar" in Muspratt's "Dictionary of Applied Chemistry" (Mackenzie, Glasgow); "Traité Complet de la Fabrication du Sucre," by Dr. C. Stammer, published by Lacroix, Paris; "Methods

of Chemical Control in Cane Sugar Factories," by H. C. P. Geerligs ; "Sugar and the Sugar Cane," by Noel Deerr ; "Manufacture and Refining of Sugar," C. H. Gill (Society of Arts Cantor Lectures) ; "Sugar Refining" in "British Manufacturing Industries" (Stanford) ; "Sugar," by Lock & Newland Bros. (Spon).

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## 9.—MANUFACTURE OF PAINTERS' OILS, COLOURS, AND VARNISHES.

I. Syllabus.—The Examination will include questions founded on such subjects as the following :—

### GRADE I.

1. Origin, methods of extraction, and description of the different oils and diluents employed in varnish and paint making.
2. Raw materials used in the manufacture of artificial pigments.
3. Natural occurrence and description of the various gum resins, asphaltums, and pitches used in varnish making.
4. Artificial pigments, their preparation, properties and uses.
5. Natural pigments, their sources, constituents, properties and preparation for use.
6. Leading chemical reactions which take place in making vermilion, chrome yellow and orange, white lead, zinc white, and other simple colours.
7. The manufacture and properties of oil and water paints, and their preparation for use. Distemper colours. Enamel paints.
8. Preparation, properties and uses of varnishes made with oil, turpentine, spirit and other diluents.

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The fee for the Examination in Grade I is *One Shilling*.

The written Examination, in both Grades, will be held on Wednesday, May 1st, from 7 to 10.

### FINAL EXAMINATION.

*Candidates for the Final Examination must hold a certificate in Grade I.*

The Examination will be Written and Practical.

(1.) **Written Examination.**—Advanced questions will be set on some of the preceding subjects, and in addition a knowledge will be required of :—

1. Chemical constitution of oils.
2. Identification of oils and diluents used in paint and varnish manufacture. Bromine and iodine values. Specific gravity. Saponification and other chemical tests. Flash point and its determination.

3. Adulteration of oils and its detection. Substitutes for turpentine, linseed oil and gum resins.

4. Methods of purification, refining and bleaching of oils.

5. Preparation and properties of boiled oil. Oxidation and its effects.

6. Blending of pigments to prepare specified tints. Identification of ingredients of a mixed pigment.

7. Methods of ascertaining staining power, body, tint and behaviour to light of pigments.

8. Adulterations of pigments and their detection.

9. Preparation of lakes and fine colours.

10. Plant required in dry colour, paint and varnish manufacture.

11. The properties of the different gum resins, and their special uses in varnish making.

12. Storage and defects of varnishes.

(2.) **Practical Examination.**—The Practical Examination will include :—

1. Identification by inspection of the following raw materials and finished products :—

Oils, raw linseed, refined and boiled ditto, tung oil, rosin oil, fish oil, cotton seed oil, turpentine ordinary and Russian, rosin spirit, coal tar naphthas, petroleum, methylated spirit, acetone, chloroform.

Barytes, terra alba, China clay, whitening.

Lead acetate and nitrate, litharge, red and orange lead, potassium and sodium bichromates, green and blue copperas, patent alum and ammonia ditto, barium chloride.

Gum resins. Zanzibar animé, Sierra Leone copal, kauri, Manilla, sandarach, mastic, shellac, rosin, dammar.

Sweated bone and Stockholm pitches, coal tar pitch, asphaltum.

Ordinary pigments such as lead chromes, Brunswick greens, emerald green, Chinese and Prussian blues, celestial blues, vermilion, vermillionettes, scarlet and crimson lake, Dutch and rose pink, zinc yellow, white lead, white zinc, lithopone, ochres, umbers and siennas, oxides of iron, ivory black, lamp and vegetable blacks, &c.

2. Identification of the same (*a*) by ordinary simple tests, including the determination of the specific gravity of liquids calculated to the third decimal place, the determination of flash point by Abel's apparatus, fractional distillation and the determination of boiling point; (*b*) by analysis, as far as simple qualitative and quantitative methods are applicable. Detection and estimation of adulteration as far as time will allow.

3. Testing of pigments and paints for comparison of their staining power.

Before commencing the Practical Work each Candidate will be allowed half an hour in which to write an outline of the methods he proposes to employ in carrying out the work assigned to him, and a list of the reagents and apparatus he will require.

The Practical Test will be held on **Saturday, May 4th**, from 2.30 to 6.30. The fee for the entire Examination is *Three Shillings and Sixpence*.

**II. Full Technological Certificate.**—For the Full Technological Certificate, the Candidate must qualify as stated in Rules 29 and 30.

**III. Works of Reference.**—Cameron's "Oils and Varnishes" (Churchill); "Oils, Fats, and Waxes," by Lewkowitsch (Macmillan); "Dr. Ure's Dictionary"; the articles on "Pigments," "Oils," and "Resins," in Muspratt's "Chemical Dictionary"; Allen's "Commercial Organic Analysis," vol. ii.; Thorpe's "Dictionary of Applied Chemistry"; "Painter's Laboratory Guide," by G. H. Hurst (Griffin, 1902); G. H. Hurst's "Painters' Colours" (Griffin); "Chemistry of the Organic Dyestuffs," R. Nietzsche; "Fixed Oils, Fats, Butters, and Waxes," Dr. Alder Wright; "Manufacture of Varnishes," by Livache and McIntosh (Scott, Greenwood); "Colour Manufacture" by Zerr and Rübencamp, translated by Mayer (Griffin); "Chemistry of Paints and Painting," by A. H. Church (Seeley); "Chemistry of Pigments," by Parry and Coste (Scott, Greenwood); "Manufacture of Mineral and Lake Pigments," by J. Bersch (Scott, Greenwood); "Manufacture of Paint," by J. C. Smith (Scott, Greenwood); "Simple Methods for Testing Painters' Materials," by A. C. Wright (Scott, Greenwood); "Analysis of Resins and Balsam," by K. Dieterich (Scott, Greenwood); "Iron Corrosion," by Andés (Scott, Greenwood); Original Papers in the Journal of the Society of Chemical Industry; The Oil and Colour Trades Journal (Scott, Greenwood).

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## 10.—OILS AND FATS, INCLUDING CANDLE MANUFACTURE.

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**I. Syllabus.**—The Examination will include questions founded on such subjects as the following :—

### GRADE I.

1. Natural occurrence and modes of preparation of vegetable and animal oils and fats.
2. Description of individual oils and fats, *e.g.*, linseed, cottonseed, sesamé, rape, arachis, castor, fish, liver, blubber, palm, cocoa-nut oils; tallow, lard, butter fat.
3. Chemical constitution of oils and fats and the principles involved in the manufacture thereof of fatty acids and glycerin.
4. Bleaching; the processes and materials employed therefor.

5. Technical methods employed for saponifying oils and fats in candle works.
6. Chemical constitution of vegetable and animal waxes.
7. Natural occurrence and methods of preparation of vegetable and animal waxes, such as carnaúba wax, sperm oil, bees' wax, wool wax, &c.
8. Physical methods employed in the examination of oils, fats, and waxes, *e.g.*, specific gravity, viscosity, solidifying point, &c.
9. Chemical methods of examining and identifying oils, fats and waxes, *e.g.*, determination of saponification value, iodine value, free fatty acids, &c.
10. Description of commercial glycerins, their uses and applications.
11. Natural occurrence and modes of preparation of mineral oils ; petroleum and shale oil industry.
12. Construction of lamps ; products of combustion.
13. Description of apparatus for the determination of flash point and ignition point.
14. Preparation of paraffin scale and paraffin wax.
15. Properties of paraffin wax, ozokerite, and ceresin.
16. Manufacture of rosin oils.
17. Modes of preparation and properties of tar oils used as lubricants.
18. Conversion of oils into lubricating greases.
19. The chemical preparation of plaited candle wicks.
20. The moulding of stearine and paraffin candles.

#### FINAL EXAMINATION.

Candidates for the Final Examination will be expected to answer more advanced questions on the subjects included under Grade I, and in certain cases to specify quantities and measurements. They will also be required to show a knowledge of :—

1. Storage of seeds and production of seed oils (*a*) by expression, (*b*) by extraction with volatile solvents.
2. Treatment of raw material for the production of animal oils and fats.
3. Methods of purification, bleaching, and refining oils, fats, and waxes.
4. Industry of edible oils and fats.
5. Physical and chemical methods of identifying individual oils, fats, and waxes, and mixtures thereof.
6. Technical methods employed for the production of fatty acids, their uses and applications, *e.g.*, "distilled" or "saponified" stearine, oleic acid.
7. Chemical determination and examination of individual fatty acids and mixtures thereof.



8. Modes of producing, and processes of refining glycerin.
9. Industry of waste fats, *e.g.*, wool grease, bone grease, tankage and sewage fats.
10. Occurrence of petroleum. Theory of its formation. Distillation of crude petroleum and products obtained thereby.
11. Shale oil industry ; its products ; and uses thereof.
12. Determination of illuminating power. Argand lamp. Carcel lamp. Detailed construction of the different parts of lamps and effect of altering those parts.
13. Determination of rate of combustion ; sanitary effects of products of combustion.
14. Transport of mineral oils in bulk and storage in bulk.
15. Selection of oils or fats for lubricating heavy or light, quickly or slowly moving, bearings—clock and watch oils—oils for sharpening stone—oils for bearings of various materials.
16. Conveyance of oils or grease to a bearing surface ; forms of bearing surfaces ; determination of the friction of different pairs of surfaces with and without a lubricant.
17. Methods of refining paraffin wax and ozokerite ; uses and applications of these products.
18. Function of a candle wick and effect of “pickling” the wick. Composition of pickling solutions.
19. Moulding machines for stearine, paraffin, and composite candles.

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The Examination in both Grades will be held on **Wednesday, May 1st, 7 to 10 p.m.** The fee for the Examination in either Grade is *One Shilling*.

**II. Full Technological Certificate.**—For the Full Technological Certificate, the Candidate must qualify as stated in Rules 29 and 30.

**III. Works of Reference.**—“Friction and Lubrication,” by R. Thurston; “Soaps, Candles, Lubricants, and Glycerine,” by W. Lant Carpenter and Leask, 2nd edition; Allen’s Commercial Organic Analysis,” vol. ii.; Thorpe’s “Dictionary of Applied Chemistry”; “Chemical Technology and Analysis of Oils, Fats and Waxes,” 4th edition, by Dr. J. Lewkowitsch (Macmillan); “Fixed Oils, Fats, Butters and Waxes,” by C. R. Alder Wright (Griffin); “Petroleum and its Products,” by B. Redwood (Griffin); “Mineral Oils and their By-Products,” by I. I. Redwood (Spon); “Lubrication and Lubricants,” by Archbutt and Deeley (Griffin); “Laboratory Companion to Fats and Oils Industries,” by Dr. J. Lewkowitsch

(Macmillan); "Chemical Technology," by Groves and Thorp, vol. ii. Lighting (Churchill); "Oils and Fats: their Uses and Applications," Cantor Lectures (1904) by Dr. J. Lewkowitsch (Society of Arts); Journal of the Society of Chemical Industry (Original Papers and Abstracts in Classes III, XII and XIII).

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## 11.—GAS ENGINEERING AND SUPPLY.

Separate examinations will be held in A.—Gas Engineering, including Manufacture, B.—Gas Supply, including Distribution and Applications.

*Candidates may bring to the Examinations tables of logarithms or slide-rules.*

### A.—GAS ENGINEERING.

I.—Syllabus.—The Examination will include questions founded on the following subjects:—

#### GRADE I.

1. The construction and setting of retorts for the destructive distillation of coal, and the furnaces or producers for heating them.
2. The methods of charging and discharging retorts, and the machine and other tools employed; the fittings of the retort bench, including the hydraulic (or dry) main.
3. The effects of modifications of carbonising temperature upon the quantity and quality of gas yielded by the coal.
4. The description of apparatus for the manufacture of water gas (uncarburetted or carburetted) and the practical working of the plant.
5. The principles and methods of gas condensation, with descriptions of apparatus employed.
6. The exhauster, its construction, its use or object, and the means by which it is actuated and controlled.
7. The methods of removing the gaseous impurities present in the gas after condensation, together with the apparatus and materials employed. The chemical reactions involved.
8. The various instruments used in gas works for ascertaining and recording pressure and exhaust, and their practical employment and significance.
9. Usual methods and apparatus employed for testing coal gas, water gas, producer gas, waste gas, &c., including the usual tests for illuminating power, calorific value, specific gravity and purity of the gas supplied to the public, and those for ascertaining the value of the by-products.

10. The simpler physical and chemical principles involved in the ordinary processes of gas manufacture and the formation of the by-products.

11. The general principles involved in the construction of the gas-holder and its tank. The advantages of the holder in gas distribution. The laying of mains and services. The necessary methods for securing an adequate supply of gas throughout the area of a district. The methods and instruments employed at the works for due control of the pressure in the street mains.

12. The fitting up of premises for the supply of gas for light, heat and power. The construction, testing, and fixing of gas meters. The influence of temperature and pressure on the volume of gas.

13. The construction of various types of gas burners. The simpler physical and chemical principles involved in the combustion of gas. The economy and efficiency of incandescent lighting as contrasted with luminous flames. High pressure lighting.

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#### FINAL EXAMINATION.

In the Final Examination more difficult questions will be set in the subjects named in the Syllabus of Grade I, and in addition a knowledge will be required of :—

1. The characteristic properties of the various kinds of coal, and their value for gas making purposes.

2. The effects of temperature upon the production of residuals.

3. Chemical composition, and physical properties of coal gas and the influence of each component upon the illuminating power and calorific value of the gas.

4. The principles of combustion, and their application to the working of retort furnaces.

5. The more advanced physical and chemical principles involved in the processes of destructive distillation of coal, and in the condensation and purification of the resulting gas.

6. The methods of complete gas analysis, including those for ascertaining the amount of impurities in the crude gas. Method of testing oil to be used in the manufacture of carburetted water gas.

7. Theory and practice of photometry, calorimetry and pyrometry. Full details of apparatus employed.

8. Gas lighting. High and low grade gases. Illuminating power. Flame temperature. Specific heats. Air supply. Incandescent lighting, theory and practice. Intensified lighting. Burners and apparatus.

9. Application of power, and labour-saving appliances in gas works.

10. The construction of gas works plant generally.
11. The management of the various portions of the plant in order to obtain the best efficiency of the apparatus, with due regard to economy in working.
12. The method of dealing with such emergencies as are of more common occurrence in gas works through breakdown of machinery or other failure of plant.
13. Working up of ammoniacal liquor and treatment of waste products.
14. Gas in competition for light, heat and power.
15. The construction, working, and efficiency of the gas engine.
16. Flow of gas in mains, theory and practice. High-pressure distribution.
17. Structural capacity. Working costs.
18. Such important recent developments of the gas industry as have been fully described in the Technical Press.

The Examination in both Grades will be held on **Saturday, April 27th**, 2.30 to 6.30 p.m. The fee for the Examination in either Grade is *One Shilling and Sixpence*.

**II. Full Technological Certificate.**—For the Full Technological Certificate the candidate will be required to qualify as stated in Rules 29 and 30.

**III.—Works of Reference.**—"Treatise on the Science and Practice of the Manufacture and Distribution of Coal Gas" (King, I.I., Bolt Court, E.C.); "Handbook for Gas Engineers and Managers," by Newbigging (King); "Practical Photometry," by Dibdin (King); "Quantitative Analysis," by T. E. Thorpe (Longmans); "Volumetric Analysis," by Francis Sutton (J. and A. Churchill); "The Guide Framing of Gas Holders," by F. S. Cripps (King); "Gas Holder and Tank Construction," by F. S. Cripps (King); "The Chemistry of Gas Manufacture," by W. J. A. Butterfield (Griffin); "Gas Engineers' Laboratory Handbook," by J. Hornby; "Gas, Oil and Air Engines," by Bryan Donkin; "Gas Manufacture," by J. Hornby (Bell & Sons); "Transactions of the Gas Institute"; "Transactions of the Institution of Gas Engineers"; Articles on "Coal Gas," by L. T. Wright, in "Thorpe's Dictionary of Applied Chemistry" (Longmans); "Chemistry for Engineers and Manufacturers," by Blount and Bloxam, vol. ii. (C. Griffin & Co.); Grove and Thorpe's "Chemical Technology," vol. iii; "Gas Lighting," by Charles Hunt (J. & A. Churchill); "Gas Analysis," by W. Hempel (Macmillan); "Gas Analysis," by C. Winkler (Gurney & Jackson); "Flow of Gas in Mains and Distribution at High Pressure," by Professor W. C. Unwin (1904); "Gas and Gas Fittings," by H. F. Hills (Whittaker); "The Flow of Gas and Proportioning of Gas Mains," by F. S. Cripps (1892); "The Mechanical Handling of Material," by G. F. Zimmer (1905); "The Steam, Gas and Oil Engine," by Professor J. Perry (1904); "The Gas and Oil

Engine," by Dugald Clerk (1902); "The Distribution of Gas," by Walter Hole (1907) (John Allan & Co.); "Handbook of Chemical Engineering," vols. i. and ii., by G. E. Davis (1904); "The Journal of Gas Lighting"; "The Gas World"; "The Journal of the Society of Chemical Industry."

## B.—GAS SUPPLY.

I. Syllabus.—The Examinations will include questions founded on the following subjects :—

### GRADE I.

1. *Mains and Services*.—Station and district governors. General principles of distribution. The various kinds of pipes and fittings used, and testing of same. Comparative advantages of wrought iron, cast iron and steel. Methods of laying. Various forms of joints and methods of jointing. Maintaining supply during alterations to existing mains and services. Causes, preventives, and methods of dealing with corrosion and deposits. Unaccounted-for gas. Causes of and testing for leakage. Syphons. Valves. Pressure gauges. Maintenance.

2. *Gas Meters*.—Principles and construction of gas meters, including slot and stop mechanism. Repairing and fixing of meters. Appliances required for and regulations governing official tests of meters.

3. *Plumbing*.—Properties and composition of various alloys, such as brass, gun-metal, etc., used for valves, cocks, gas fittings, etc. Solders, their composition, preparation and uses. Methods of soldering.

4. *Interior Fittings*.—Description and size of pipes in relation to requirements. Distribution of light. Testing of installations. Antivibrators. Movable pendants. Other fittings and accessories. Simple principles of ventilation. Method of governing pressure beyond the meter.

5. *Luminous and Bunsen Flames*.—Theory and application of.

6. *General Lighting*.—Construction of flat flame, argand, regenerative and incandescent burners. Regulation of gas and air supply to burners. Causes and prevention of mantle breakages. Influence of shades, globes, wall papers, etc., on light efficiency.

7. *Outside Shop and Street Lighting*.—Types and construction of lanterns including burners and other fittings. Principles of windproof lanterns. Suspension brackets and lamp pillars.

8. *Use of Gas for Heating purposes*.—Construction, types and fixing of cookers, boilers, fires, irons, etc. Hot water circulating appliances. Geysers. Flues for waste products.

9. *Gas Power*.—Construction and practice of the gas engine.

10. *Tools and Appliances.*—A full knowledge must be obtained of all the tools and appliances necessary for repair and extensions from the works' governors to the point of combustion.

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#### FINAL EXAMINATION.

In the Final Examination more difficult questions will be set in the subjects named in the Syllabus of Grade I, and in addition, a knowledge will be required of:—

1. *Mains and Services.*—Flow of gas in mains, theory and practice. Electrolysis and electric fusion. Pressures and pressure recording instruments. Main-laying costs and relation to prospective income. First aid in cases of "gassing." High-pressure distribution. Fans, blowers, and compressors. Subways, advantages and disadvantages of. The carrying of mains over bridges, and under rivers and canals. Explosive mixtures.

2. *Interior Fittings.*—Specifications. Principles and construction of various types of burners and plant for intensified lighting. Lighting of churches, factories, and other large buildings. Theory and practice of ventilation by gas. Lighting for special purposes, such as billiard table, etc. Switch lighting.

3. *General Lighting.*—Efficiency of flat flame, incandescent and other burners. Low and high pressure lighting. Theory, manufacture, composition, and testing of the incandescent mantle. Illuminating effect of different methods of lighting. Flame temperature. Air supply. The hygiene of gas.

4. *Outside Shop and Street Lighting.*—Public lighting. Testing for illuminating power and illuminating effect. Advertising and illuminating devices. Automatic lamplighting appliances.

5. *Influence of Reflection on Indoor and Outdoor Lighting.*—The reflecting powers of various surfaces and the means of ascertaining same.

6. *Gas used for Heating purposes.*—Industrial and domestic uses of gas. Testing of heating appliances. The application of refractory materials to the construction of heating (and lighting) appliances. Influence of air supply and flame temperature.

7. *Gas Power.*—Calorific power. Comparative costs and thermal and mechanical efficiencies of the gas engine, and competing power agents. Gas-driven electricity plants.

8. *Physics and Chemistry as applied to Lighting and Heating.*—The physical laws of temperature, radiation, conduction, convection, reflection and refraction. The physical and chemical laws concerning diffusion and humidity. Instruments used for investigation, including spectrosopes, hygrometers, and thermoscopic appliances.

9. *Gas in competition for light, heat and power.*

10. *Statutory Enactments, etc.*—The general legal obligations affecting gas supply. The Factory and Workshops Acts so far as they relate to the use of gas lighting and heating appliances, and the purity of the atmosphere in rooms. The relative fire risks of various illuminants, and effect on insurance rates.

11. *Such important recent developments* in any of the foregoing subjects as have been fully described in the Technical Press.

The Examination in both Grades will be held on **Saturday, May 4th, 2.30 to 6.30 p.m.** The fee for the Examination in either Grade is *One Shilling and Sixpence*.

**II. Full Technological Certificate.**—For the Full Technological Certificate the candidate will be required to qualify as stated in Rules 29 and 30.

**III. Works of Reference.**—"The Distribution of Gas," by Walter Hole (1907) (John Allan & Co.); "Coal Gas as a Fuel," by Thomas Fletcher; "Flow of Gas in Mains, and Distribution at High Pressure," by Professor Unwin (1904); "The Flow of Gas and proportioning of Gas Mains," by F. S. Cripps (1892); "The Gas and Oil Engine," by Dugald Clerk (1902); "Gas, Oil, and Air Engines," by Bryan Donkin; "Natural and Artificial Methods of Ventilation" (Robert Boyle & Sons, 1899). The following series of lectures by Professor Lewis:—"The Incandescent Gas Mantle, and its use," (Cantor Lectures before the Society of Arts, 1900); "The Future of Coal Gas and allied Illuminants," (Series of Lectures before the Society of Arts, 1902), "The use of Gas from a hygienic Standpoint." Groves' and Thorpe's "Chemical Technology," vol. iii.; "Gas Lighting," by Charles Hunt (J. and A. Churchill); "Treatise on the Science and Practice of the Manufacture and Distribution of Coal Gas" (King, 11 Bolt Court); "Handbook for Gas Engineers and Managers," by Newbigging (King); "Gas Manufacture, by J. Hornby (Bell & Sons); "The Temperature of Flames," by A. Smithells (Inst. of Gas Engineers Trans., 1905); "Handbook of Practical Gas Fitting," by Walter Grafton (Batsford, 1907); "Service Chemistry," by Vivian B. Lewis (H. Glaiser).

**Periodicals.**—"The Journal of Gas Lighting"; "The Gas World"; "The Illuminating Engineer."

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## 12.—IRON AND STEEL MANUFACTURE.

The Examinations will be held in three grades. Candidates will be permitted to present themselves for the Examination in Grade I in a year either previous or subsequent to that in which they present themselves for Examination in Grade II, or to enter for both Grade I and Grade II in the same year. No Candidate will, however, receive a Certificate until he shall have passed the

Examinations in both grades. The successes of Candidates in either grade will be notified to the Secretaries of the Centres at which they were examined.

Prizes will be awarded on the results of the Examination in Grade II to those Candidates only who have passed Grade I in a previous year, or who pass both parts in the same year.

Candidates for the Final Examination must hold a Certificate in Grade II.

In order to encourage Teachers to devote special attention to those processes of Iron and Steel Manufacture which may be most suitable for their respective districts, the Syllabus has been divided into two parts, and in the Examination a number of questions will be given so as to allow considerable choice in the selection. All Candidates will, however, be expected to afford evidence of a general knowledge of the subject as a whole, and in order to pass in the first class a Candidate will be expected to answer satisfactorily questions both in Iron Manufacture and in Steel Manufacture. In the Final Examination Candidates will be permitted to select their questions either from one section only or from both.

#### I. Syllabus.—

##### GRADE I.

##### *Manufacture of Iron.*

1. Composition and general characters of the chief ores of iron.
2. Construction and mode of working of blast furnaces.
3. Hot and cold blast; effects of these and of variations in amount of fuel and flux on the production and character of the iron made.
4. Physical characters of pig irons from various classes of ore. Grey, mottled, and white irons. Bessemer, mine, and cinder pigs. Numbering of irons.
5. Physical characters of charcoal, coal and coke used for iron smelting.
6. Chemical and physical properties of iron used for foundry purposes.
7. Chemical and physical properties of forge pigs.
8. Refining, puddling, and the production of finished iron.
9. Chemical composition of fettling and of wrought iron.
10. A general knowledge of the construction of furnaces, hammers, and rolls required for the manufacture of wrought iron.
11. Manufacture of malleable iron castings from crucibles, cupolas, or the open-hearth furnace. Practice and theory of ore annealing.



### *Manufacture of Steel.*

12. Compositions and properties of the materials used for acid and basic linings for converters and steel furnaces.

13. Outline of the construction of cupolas, converters, and of the general arrangement of a Bessemer plant.

14. Outline of the construction of gas producers, melting furnaces and regenerators, and of the general arrangement of an open-hearth steel plant,

15. Ingot moulds, nozzles, and stoppers ; making up the tap-hole, and repairing the bed of the open-hearth furnace between heats.

16. Outline of the reactions involved in the various processes.

17. A general idea of reheating furnaces, soaking pits, hammers, and rolls used for converting ingots into the various forms of steel required for the market.

18. General knowledge of the furnaces used for melting in crucibles by means of coke or gas.

19. Chemical and physical characteristics of coke suitable for steel melting.

20. Composition and physical characters of the various materials used for the manufacture of crucible steel, viz., Swedish, Walloon, and Lancashire hearth bars, unconverted and cemented, charcoal, Swedish white iron, the various classes of steel scrap, and ferro-manganese.

21. Hammering, rolling, and reeling of crucible steel.

22. Shear and double shear steel, composition and method of manufacture.

23. Testing steel in tension, with arithmetical calculations connected therewith.

The Examination in Grade I will be held on **Monday, April 29th**, from 7 to 10 p.m. The fee for the Examination is *One Shilling*.

### GRADE II.

Candidates passing the Examination in Grade II will not receive Certificates unless or until they shall have passed in Grade I also. See pages 60 and 61.

### *Manufacture of Iron.*

1. Preparation of raw ores for smelting ; changes in composition thereby produced.

2. Mechanical preparation of iron ores. Magnetic concentration.

3. Subsidiary appliances required in the construction and working of blast furnaces, *e.g.*, hoists, blast heating stoves, and apparatus for utilization of surplus gases.

4. Mechanical charging appliances. Pig casting machines, pig breakers, and similar appliances.

5. Chemical nature of fluxes requisite under various conditions. Composition of slags.
6. Handling and utilization of blast furnace slags.
7. Chemical composition of charcoal, coal, and coke used for iron smelting. Composition of gases from the blast furnace.
8. Chemical and mechanical characteristics of pig irons from various classes of ore.
9. Iron-founding, including cupolas, moulds, ladles, and foundry appliances.
10. Machine moulding, core making, foundry sand and compositions.
11. Production of castings of special kinds, *e.g.*, large castings, fine castings, chilled castings, &c.
12. The theory of puddling. Machine puddling.
13. Mechanical properties of the various qualities of wrought iron. Composition and tests of wrought iron suitable for various purposes.
14. Direct production of wrought iron.
15. Composition of iron suitable for the production of malleable castings. Conditions under which carbon separates from white iron. Other changes during the annealing process.

### *Manufacture of Steel.*

16. Theory of the acid Bessemer blow. Theory of the acid open-hearth process. Slags produced.
17. Theory of the basic Bessemer blow. Theory of the basic open-hearth process. Slags produced.
18. The functions of manganese, silicon, and aluminium. Influence of varying quantities of silicon and manganese on the temperature of the acid Bessemer blow.
19. Comparative advantages and disadvantages of blowing metal direct from the blast furnace, and metal re-melted in cupolas.
20. Chemical and physical characteristics of coke suitable for Bessemer cupolas and of coal for gas producers. Composition of producer gases.
21. Bessemer, open-hearth, and crucible steel castings. Nature and elimination of blow-holes.
22. Low pressure surface blown modifications of the Bessemer process and their products.
23. Modified open-hearth processes conducted in tilting furnaces, &c., *e.g.*, the Talbot process; the Bertrand-Thiel process, &c.
24. Methods of dealing with emergencies, *e.g.*, hot or cold heats or blows.

25. Manufacture and compositions of clay and plumbago crucibles. Annealing clay crucibles. Stands and covers. Sanding.

26. The cementation process. Bar numbers.

27. Impurities eliminated or introduced in crucible melting. Calculation of mixtures.

28. Causes leading to "runners" in crucibles, *e.g.*, inclusion of basic granules, frost-crack, &c.

29. Practice of hardening and tempering steel.

The Examination in Grade II will be held on Tuesday, April 30th, from 7 to 10 p.m. The fee for the Examination is *One Shilling and Sixpence*.

#### FINAL EXAMINATION.

*Candidates for the Final Examination must hold a Certificate in Grade II.*

Candidates for this examination will be expected to answer questions dealing with subjects included in Grades I and II, and may select their questions either from one section only or from both. The following additional subjects will also be included.

#### *Manufacture of Iron.*

1. Geographical and geological distribution of iron ores. Relation of composition to geological distribution.

2. Handling and transportation of iron ores and other materials employed.

3. Thermal calculations relative to the calorific value of fuel and of blast-furnace gases, and to the reactions of the blast furnace.

4. The testing of cast iron otherwise than by chemical analysis.

5. Theories of puddling. Calculations relative to the yield of pig iron of given composition.

6. The micro-structure of pure iron, of wrought iron, and of various kinds of cast iron.

7. The production of spiegeleisen, ferro-manganese, ferro-chrome, and ferro-silicon, in the blast furnace. Properties of these alloys.

8. The applications of electricity in the production of iron and iron alloys.

#### *Manufacture of Steel.*

1. The relative position of the steel trade in the chief steel-making countries, and the reasons for the adoption of certain methods or processes in particular countries or districts.

2. The general arrangement of a steel works, and the appliances and methods used in handling, charging, rolling, pressing, hammering, or otherwise shaping large masses of steel.

3. Chemical and thermal calculations relative to the various steel processes, and to producer gas.

4. Liquation and segregation in ingots. Methods of producing sound and uniform metal.

5. Influence of heat treatment of steels of various kinds. Theory of hardening, tempering, and annealing.

6. Special materials used in steel manufacture, such as ferro-chrome, ferro-nickel, tungsten, &c. Properties of the special steels so produced.

7. Influence of carbon and other elements on the tenacity and ductility of the various qualities of steel. Composition necessary to fulfil given mechanical specifications.

8. Applications of electricity in the production of steel.

The Final Examination will be held on Tuesday, April 30th, from 7 to 10 p.m. The fee for the Examination is *One Shilling and Sixpence*.

**II. Full Technological Certificate.**—For the Full Technological Certificate, the Candidate must qualify as stated in Rules 29 and 30.

**III. Works of Reference.**—In addition to the smaller text books students may refer to Turner's "Metallurgy of Iron" and "Lectures on Ironfounding"; also to Harbord's "Metallurgy of Steel" and Stead's translation of Osmond's "Microscopic Analysis of Metals," all of which are published by Griffin and Co.; "Metallurgical Calculations," by J. W. Richards (McCrow Publishing Co., New York), Brearley and Ibbotson's "Analysis of Steel Works Materials" (Longmans), Longmuir's "Elementary Practical Metallurgy, Iron and Steel" (Longmans), Goeren's "Introduction to Metallography" (Longmans). Among older standard works of reference may be mentioned Bell's "Principles of the Manufacture of Iron and Steel," Howe's "Steel," and Percy's "Iron and Steel." Students should specially refer to the "Journal of the Iron and Steel Institute" for accounts of new processes and inventions published since the compilation of the various works of reference. Much valuable information may also be gained from the Transactions of the Institute of Civil Engineers; of the Institute of Mechanical Engineers; of the American Institute of Mining Engineers; of the American Foundrymen's Association; and of the International Association for testing materials (Baumaterialienkunde). Students who read German will find the works of Professor Ledebur and of Dr. Wedding of great value.

### 13.—PAPER MANUFACTURE.

With a view of encouraging young persons engaged in Paper Mills to attend classes for technical instruction in paper manufacture, the Paper Makers' Association will give a prize of £1 10s. to each Candidate who passes in the First Class at the Institute's Final Examination, and a prize of £1 to each Candidate who passes in the Second Class.

The Association will also give a prize of 15s. to each Candidate who passes First Class and a prize of 10s. to each Candidate who passes Second Class at the Examination in Grade I.

No Candidate who has previously obtained a prize in either grade will be eligible for another prize in the same grade.

**I. Syllabus.**—The Examination will include questions founded on such subjects as the following :—

### GRADE I.

1. Fibre-yielding raw materials. Chemical and structural features. Celluloses and compound celluloses.

2. Mechanical preparing processes. Sorting, picking, cutting, dusting.

3. Boiling processes. (a) Alkaline treatments. Theory of action. The various types of boilers or digestors for rags, esparto, straw, wood. (b) Acid processes. The bisulphite system of wood treatment. (c) Treatment of waste papers, "broke," and air dry pulps.

4. Washing processes. Special methods directed to economical recovery of chemicals. Breaking engines: construction and working.

5. Bleaching processes. Chemistry of hypochlorites and their action: electrolytic processes of production. The variations of bleaching methods commonly practised. Auxiliary agents and their effects. Conditions affecting economy of process and permanence of bleaching effects.

6. Beating process. Construction and working of beaters. The factors of the treatment considered in relation (a) to the working of the pulp on the machine, (b) to the structure and mechanical properties of the finished web of paper.

7. Engine sizing. Rosin size: preparation and composition. Starch, casein. Alum and sulphate of alumina. Loading and colouring. Tub sizing. Preparation of gelatine size.

8. The paper machine and its adjuncts. Stuff chests, strainers, sand tables, the wire, couch and press rolls, felts, drying cylinders. Adjustments of speed. Backwater. Effects of rapid and slow drying. Water marking. The hand-making process. "Board" processes.

9. Calenders. Appliances for damping. Effects of calendering upon the mechanical properties of the paper. Plate-glazing.

10. Treatment and utilisation of waste products and spent liquors. Soda recovery. Principles of multiple effect evaporation.

11. The various classes of paper in relation to composition and trade uses. Sizes and weights.

12. The laboratory. Methods of sampling for analysis. Qualitative examination of papers to determine composition, pulp, sizing, loading.

Estimations of moisture and ash.

Determination of specific gravities by weighing and by hydrometers.

Mechanical properties of papers: quantitative measurements.

## FINAL EXAMINATION.

*Candidates for the Final Examination must hold a Certificate in Grade I.*

In the Final Examination more difficult questions will be set on the above subjects, and in addition a knowledge will be required of :—

1. The mill : site, general arrangement, water supply, desirable features in each. Treatment of waste waters.

2. Costs of production in relation to raw materials, labour, chemicals, and steam.

3. Laboratory Work : methods of estimating cellulose : valuation of raw fibrous materials. Chemical characteristics of celluloses and compound celluloses. Test solutions and their preparation. Quantitative estimation of : Acids, Alkalies ; Hypochlorites ; Sulphites and Bisulphites (sulphurous acid), Sulphates of Alumina. Comparative colouring powers of dyes and pigments. Chemical methods generally required for the routine of the mill.

4. Microscopic features of fibres in relation to paper-making value : quantitative analysis of papers (pulp) by microscopic methods.

5. Special varieties of papers : blottings, vegetable parchments, imitation parchments, filtering papers, enamel papers, waxed papers, water proof papers, "safety" cheque papers, drawing papers, photographic papers.

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The Examination in both Grades will be held on Saturday, May 4th, 2.30 to 6.30 p.m. The fee for the Examination in either Grade is *One Shilling and Sixpence*.

II. Full Technological Certificate.—For the Full Technological Certificate, the Candidate must qualify as stated in Rules 29 and 30.

III. Works of Reference.—"Manufacture of Paper," by C. Hofmann (Sampson Low and Marston) ; "Praktisches Handbuch der Papier-Fabrikation," by Carl Hofmann (Verlag der Papier Zeitung, Berlin, 1897) ; "The Practical Paper Maker," by J. Dunbar ; "The Art of Paper Making" (Kent & Co.) ; "Practical Paper Making," by George Clapperton (Crosby Lockwood, 1894) ; "Chapters on Paper Making, and Theory and Practice of Beating," by C. Beadle, London, 1904 ; "Chapters on Papermaking," Vol. 2, by C. Beadle, London, 1905 ; "The Dyeing of Paper Pulp," by J. Hübner, 1901 ; "Cellulose," by Cross and Bevan (Longmans, 1901) ; "Technology of Paper Trade," Society of Arts ; "The Manufacture of Paper," by C. T. Davis (Sampson Low, Marston & Co.) ; "Paper Making," by C. F. Cross and E. J. Bevan (E. & F. N. Spon) ; "The Art of Paper Making," by Alex. Watt (Crosby Lockwood & Son) ; "The Chemistry of Paper Making" by Griffin and Little (H. Lockwood, New York) ; "Paper

Technology," by R. W. Sindall (Griffin); "Paper Manufacture," Cantor Lectures by J. Hübner (Society of Arts, 1903); "Factory Book-keeping for Paper Mills," by J. McNaughton ("Wood Pulp," Ltd.); the articles "Paper" and "Cellulose" in various modern Dictionaries of Arts and Manufactures; Special Articles in "Paper Trade Review," "Paper Maker," "Paper and Pulp," "Papier Zeitung," "Wochenblatt für Papierfabrikation," "Journal of the Society of Chemical Industry."

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#### 14.—PHOTOGRAPHY.

The Examination in Photography will consist of two parts:—Section A, PURE PHOTOGRAPHY, and Section B, PHOTO-MECHANICAL PROCESSES. Candidates may be examined in *either* of these two sections.

##### GRADE I.

The Examination in Grade I of either section will consist of a *Practical* and a *Written Examination*.

*No Candidate will be admitted to the Written Examination who has not previously passed the Practical Examination.*

To enable Candidates to qualify for the Written Examination in Grade I, Local Practical Examinations will be held at convenient times in the Session preceding the Written Examination. A Practical Examination may be held in any town where there is a class registered by the Institute, or in such other places where *at least five* Candidates notify, through the Local Secretary, their wish to be examined. The Local Examinations will be held under the personal supervision of Examiners nominated by the Local Authority, subject to the approval of the Institute. The date at which a Local Examination is to be held may be fixed at any time between January 1st and March 2nd that may be arranged between the Secretary of the Local Committee and the Local Examiner, provided that *at least fourteen days' notice* is given to the Institute of the date fixed for such Local Examination; and the Local Secretary will be required to forward to the Institute, within eight days after the holding of such Examination, under the signature of the Local Examiner, the names of any Candidates who may have satisfied the Examiner of their practical knowledge of Photography. The subjects of the test are given in the Syllabus of each section.

The fee for the Practical Examination only will be *Two Shillings and Sixpence*. The fee for the Written Examination is *One Shilling*.

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##### I. Syllabus.—

##### SECTION A.—PURE PHOTOGRAPHY.

(1.) The Local Practical Examination will include the following tests:—To focus, expose, and develop a negative of a person or landscape; to print, tone, fix, and mount a P.O.P. or a platinotype print.

(2.) The Written Examination will include questions on such subjects as the following :—

1. The elements of Photographic Optics. The Photographic Camera and its adjuncts, lenses, diaphragms, shutters, shades, &c.
2. The practice and theory of the gelatine dry-plate process, including the use of colour sensitised plates, lantern-slide making, copying and enlarging, but exclusive of emulsion making; the composition of and defects in gelatine dry plates; the defects of gelatine negatives and transparencies, their causes and remedies.
3. Various methods of developing, fixing, intensifying, and reducing negatives, with a general knowledge of the chemicals employed.
4. Silver printing by print-out processes, including vignetting and printing in clouds, toning and fixing; contact printing on gelatino-bromide and "gas-light" paper; platinotype printing.
5. Retouching and spotting; mounting prints.
6. The studio, dark room, and printing department, and their requirements. Lighting of the sitter, &c.

#### SECTION B.—PHOTO-MECHANICAL PROCESSES.

(1.) The Local Practical Examination will include the following tests :—

(a.) To produce a negative of a simple line drawing and also of a wash drawing for the production of a type-high printing block by means of wet collodion, collodion emulsion or gelatino-bromide dry plates, the choice of process being left to the candidate.

(b.) To print and etch a line or half-tone plate suitable for a type-high printing block, from a negative supplied.

(c.) To make a photo-lithographic transfer (including the sensitizing of the paper), and to produce a direct print suitable for surface printing upon stone or zinc from a given negative.

(d.) To make a collotype plate and to produce a print on the same from a negative supplied, or from a given exposed and developed collotype plate to produce prints.

Candidates may choose one or other of the tests, but they may not attempt more than one test. Notice must be given to the Local Secretary as to which test the Candidate intends to take at least fourteen days before the date of the Local Practical Examination.

(2.) The Written Examination will include questions founded on the following subjects :—The apparatus used for negative making both in the studio and in the dark room. The elementary principles of negative making—the formation of images by means of lenses, the action of light upon sensitive surfaces, development and fixation. Practical details of importance in the manipulation of the wet collodion, collodion emulsion and gelatino-bromide processes.



A simple knowledge of the properties of proteid substances as used in photo-mechanical photography—albumen, gelatine, gelatose (fish glue and the like), and their behaviour towards reagents. The chromates and bichromates, and the preparation of sensitive media.

The principles and practice (in so far as relates to essentials) of the following :—

The production of a relief block in line and half tone, and the direct and transfer processes of photo-lithography.

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### FINAL EXAMINATION.

*Candidates for the Final Examination in either Section must hold a certificate in Grade I of that Section.*

The Final Examination is both Written and Practical.

The Fee for the Final Examination (Written and Practical) in either Section is *Three Shillings and Sixpence*.

Practical Examinations will be held at any Centre at which the necessary arrangements can be made, provided not less than five Candidates apply to be examined in the same Section (A or B).

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### SECTION A.—PURE PHOTOGRAPHY.

(1.) **Written Examination.**—Candidates will be expected to answer more difficult questions in the subjects of Grade I, and, in addition, a knowledge will be required of—

1. The theory of the photographic image, of development, fixing, intensification, and reduction.

2. The theory of light as applied to photography, including a general knowledge of spectrum and orthochromatic photography.

3. The principles of photographic optics.

4. The theory and practical use of sensitometers for testing the speed and gradation of plates; and also their uses in printing processes.

5. The principles and practice of the preparation of gelatino-bromide and gelatino-chloride emulsions.

6. Collodio-bromide emulsions, their preparation and use.

7. Carbon printing; methods of printing with bichromates and with iron salts; enamels.

8. The theory and practice of colour-photography.

9. Applications of photography to scientific and technical purposes.

(2.) **Practical Examination.**—Candidates will be required to show proficiency in conducting any of the following practical operations :—

1. To develop gelatino-bromide plates previously exposed (correctly or otherwise) by the Examiner.
2. To reduce or intensify gelatino-bromide negatives.
3. To print, tone or develop, fix, and mount a silver, platinotype, or carbon print.
4. To test a sample of glass or fabric to be used in lighting the dark room.
5. To test the sensitiveness and gradation of a plate.
6. To find the focus of a lens either corrected or uncorrected, or to examine a lens as to its suitability for different photographic purposes.
7. To copy a drawing or engraving.
8. To make an enlargement from  $\frac{1}{4}$  plate.
9. To make a lantern slide by contact or in a camera.
10. To produce a colour photograph by a screen-plate process.

The care, cleanliness, and neatness with which Candidates execute their work will be taken into account in the award of marks.

(3.) **Specimen Work.**—Candidates will also be required to send in not later than April 29th not fewer than three nor more than six negatives, not less than quarter-plate size nor more than whole-plate, together with mounted prints made from each of them by any ordinary photographic printing process or processes that the Candidate may select. The negatives and prints must be accompanied by a Statutory Declaration made by the Candidate to the effect that the selection of the subjects and the whole of the work (except the manufacture of the plates, sensitive paper, and mounts) involved in the production of the negatives and prints has been done by the Candidate without assistance from any other person and within the twelve months preceding the date of the Examination. Forms for the Declaration may be had on application.

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#### SECTION B.—PHOTO-MECHANICAL PROCESSES.

(1.) **Written Examination.**—Candidates will be expected to answer questions of a more advanced nature in the subjects of Grade I, in addition to the following :—

The principles underlying the photographic rendering of colour. The correct translation of colour into monochrome. The different

methods which are employed in photo-mechanical processes for the rendering of gradations of light and shade. The principles and practice (in so far as relates to essentials) of the following processes:—

(1.) The production of three-colour blocks by the type-high process. (2) Photogravure. (3) Collotype.

Candidates are reminded that in the written papers more value will be attached to answers which show a knowledge of the essential principles involved than to lengthy details of a merely manipulative nature. They are urged, therefore, to pay special attention to the theoretical parts of the subject. They must also understand that the Practical Test is a very important part of the Examination.

(2.) **Practical Examination.**—The Candidate will be required to show proficiency in practical operations in *one* of the above processes, numbered (1), (2), (3), including the preparation of negatives suitable for the class of work chosen; or, in lieu thereof, he may select (4) negative making alone, in which case he must be prepared take tests in any *two* of the following groups:—(a) continuous tone negatives from pictures in colour, (b) continuous tone negatives from drawings in monochrome and photographs, (c) continuous tone negatives from objects in relief, (d) broken tone (seven) negatives from monochrome originals such as wash drawings or photographs, (e) line negatives from originals in line, such as pen and ink drawings, wood engravings, plans or tracings. Notice must be given to the Local Secretary as to the test which the Candidate will take at the time of his application for examination.

The Examinations will be held on the following dates:—

Section A.—Written (Grade I and Final), Tuesday, April 30th, from 7 to 10 p.m.

Practical (Final), Saturday, May 4th, from 2.30 to 6.30 p.m.

Section B.—Written (Grade I and Final), Wednesday, May 1st, from 7 to 10 p.m.

Practical (Final), Saturday, May 11th, from 2.30 to 7.30 p.m.

II. **Full Technological Certificate.**—For the Full Technological Certificate, the Candidate must qualify as stated in Rules 29 and 30.

III. **Works of Reference.**—Section A.—*Grade I.*—"Science and Practice of Photography," Chapman Jones (Iliffe and Sons); "Instruction in Photography," Abney (Iliffe and Sons); "Ilford Manual of Photography," Bothamley (The Ilford Co.); "The First Book of the Lens," Welborne Piper (Hazel, Watson and Viney); "The Lens," Bolas and Brown (Dawbarn and Ward);

"Photographic Lenses," Beck and Andrews (Beck); "The Photography of Coloured Objects," Mees (Wratten and Wainwright).

*Final Examination.*—In addition to the foregoing; "Ausführliches Handbuch der Photographie," Eder (Knapp); "Traité Encyclopédique de Photographie," Fabre (Gauthier-Villars); "Dictionary of Photography," Wall and Bolas (Hazell, Watson and Viney); "Treatise on Photography," Abney (Longmans, Green and Co.); "Wet Collodion Photography," C. W. Gamble (Hazell, Watson and Viney); "Photographic Optics," Lummer, translated by S. P. Thompson (Macmillan and Co.); "A System of Applied Optics," H. D. Taylor (Macmillan and Co.); "Geometrical Optics," T. H. Blakesley (Whittaker); "Theory of the Photographic Process," Sheppard and Mees (Longmans, Green and Co.); "Telephotography," T. R. Dallmeyer; "Elementary Telephotography," Marriage (Iliffe and Sons); "Photo-micrography," Pringle (Iliffe and Sons). The Journal of the Royal Photographic Society, and the current English and Foreign Photographic Journals.

Section B.—*Grade I and Final Examination.*—The books on Pure Photography enumerated under Section A. "The Wet Collodion Process," Arthur Payne; "Practical Notes on the Preparation of Drawings for Photographic Reproduction," Major-General J. Waterhouse (Kegan Paul, Trench, Trübner and Co.), "The Half-tone Process," Verfasser (Iliffe and Sons); "Photo-engraving," Farquhar (Dawbarn and Ward); "Photo lithography," Fritz and Wall (Dawbarn and Ward). "Handbook of Photography in Colours," by Bolas and Tallent (Marion and Co.); "Three-colour Photography," by Von Hübl, translated by H. O. Klein (Penrose and Co.); "Natural Colour Photography," König and Wall (Dawbarn and Ward); "Photogravure in Intaglio," Denison (Iliffe); "The Penrose Annuals" (Penrose and Co.); Klimsch's "Jahrbuch" (Hunters, Ltd.); Eder's "Jahrbuch" (Knapp, Halle). The Journal of the Royal Photographic Society, and the current English and Foreign Photographic and Printing Journals.

## 15.—POTTERY AND PORCELAIN MANUFACTURE.

With a view to encouraging those engaged in this industry to go through a continuous course of instruction, occupying at least three years, the examinations will be divided into three Grades, of which Grade I will be of an elementary character. It is expected that the students of classes in this subject will attend a course of practical lessons in Physics and Chemistry in connection with the subjects indicated in the Syllabus for Grade I.

## I. Syllabus.

### GRADE I.

The examination in Grade I will include questions on the rudiments only of the following subjects; but Candidates will be expected to have acquired clear, precise, and accurate knowledge of the principles involved, and of their application to the processes of the manufacture :—

#### A.—General Subjects.

1. Units of Measurement—length, area, volume, weight. The Metric system and its relation to the British system.

2. The principle of Archimedes. Simple methods for the determination of the density of liquids and solids. Hydrometry. Porosity of fired and unfired bodies and the methods for the determination of the same.

3. The measurement of temperature. Ordinary thermometers. Fixed points of thermometers. Thermometer scales—the relation between the Fahrenheit and Centigrade scales. Distinction between heat and temperature. Specific heat.

4. Change of state. Latent heat of fusion and vaporization of water. Effects of heat on different materials illustrating decomposition, fusion, vaporisation. Examples :—Water, ice, dry distillation of coal, burning of limestone.

5. The effects of heat on the simpler materials used by potters. Co-efficient of thermal expansion. Aqueous solutions and solubility. Influence of temperature on the solubility of materials in water. Water—hard and soft.

6. Oxidation; rusts; oxides of iron, lead, hydrogen, carbon. Combustion. Part played by air in combustion. Composition of air by volume. Products of combustion of common fuels—wood, coal, and coal gas.

7. The more important physical properties (colour, fusibility, specific gravity) and empirical formulæ of silica, alumina, lead oxides, lime, magnesia, iron oxides, alkalies. Solutions of clay and silica in molten lead oxide.

#### B.—Applied Subjects.

1. Materials composing the bodies of common pottery, bricks and tiles, and English earthenware and china.

(a) *The Plastic Materials.*—The general physical properties and approximate chemical composition of the following clays :—China clay, ball clay, fire clay and brick clay. The influence of variations in composition of the above clays on their working properties, and on the colour, hardness, density, &c., of fired bodies. The occurrence and distribution of these clays in England. The preliminary preparation required to fit them for potters' use, including "weathering," "washing," &c.

(b) *The Hardening Non-plastic Materials*.—Silica in its various forms. Sand and flint; their occurrence and preparation. Ground pitcher, "Grog," &c. The part these materials play in a body, both during the making and the firing.

(c) *The Fusible Non-plastic Materials*.—Felspars and Felspathic materials such as China stone; their occurrence, general composition, preparation and use. Bone ash, its preparation, composition and use. The part these materials play in a body, both during the making and the firing.

2. Body mixing by both dry and wet methods. The relative advantages of different methods. The sieving and magnetizing of slip. The necessary precautions for securing the efficacy of these various processes.

3. Preparation of Potter's clay. Slip kiln heated by flues or by steam pipes. Filter presses. Pug mills and similar appliances. "Wedging" of clay.

4. Processes for shaping. Throwing and turning. Jolley and jigger work. Pressing and casting. Making from dies both plastic and dust. Making by expression and by compression.

5. Working properties of the body. Plasticity or the reverse of various ordinary bodies. Contraction in drying and its cause. Necessary precautions in the making processes and in drying to obtain a practical result. Methods of adjusting composition, degree of fineness, &c., to meet varying requirements.

6. Moisture in the atmosphere; saturation of air with moisture; the measurement of the amount of moisture in air; hygrometers; evaporation; efflorescence and deliquescence; the effects of varying amounts of moisture upon the composition of a body and on the market value of the materials.

7. Drying—natural and artificial. Tunnel dryers. Potter's stoves. Requirements of a potter's stove. Ventilation and its importance in the drying-room. Mechanical appliances to stoves in china and earthenware factories.

No Certificates will be awarded on the results of the Examination in Grade I, but the Candidates' successes will be communicated to the centres where they were examined.

The Examination in Grade I will be held on Monday, April 29th, from 7 to 10. The fee for the Examination is *One Shilling*.

## GRADE II.

In addition to more advanced questions on the subjects covered by the syllabus for Grade I, questions may be set on the following:—

1. Natural agents at work in the formation of clays. Primary and secondary clays. Origin of red and cane marls, and shales.

Varieties of ball and china clays. The washing and refining of china clay.

Composition of the different body materials; deleterious impurities; effects of impurities in clays on the ware. Methods of testing body materials for specific uses.

Physical properties of the body materials; plasticity, specific gravity, tenacity, shrinkage—wet to dry, and dry to fired, colour and fusibility.

2. *Bodies*.—The composition, preparation and working properties of the bodies used in making English pottery. The scumming of terra-cotta and other bodies. Its cause and cure. The compounding of a body by balancing the properties of different substances. The influence of the size of particles on the plasticity and working properties generally. Remedies for defects arising in practice.

3. Wet and dry, cylinder and pan grinding. Chert runners, Welsh pavers, French Burrs. Separation of materials into particles of different fineness; gradimeter, Schone's apparatus. Influence of fineness of grinding on the firing point of bodies. Dry weight of slip; slip weight of slip. Calculation of slipmaker's cards.

4. Simpler types of up-and-down-draught brick and pottery ovens; temporary and permanent clamps—"Dutch," "Scotch," Newcastle, Wilkinson's, Minton's; "Hopper" mouths; approximate dimensions of typical up-and-down-draught ovens. Relative merits of up-and-down-draught ovens.

Draught and its causes. Measurement of draught. Chimneys. Smoke suppression. Principles of firing biscuit ovens. Reducing and oxidising atmospheres. General results of inaccurate firing. Defects apparent on drawing biscuit ovens.

Placing—earthenware, china, tiles, bricks.

5. *Fired Bodies*.—The density, hardness, and porosity of fired bodies. Means of estimating the same. The part played by fineness of particles in the results obtained. The practical means used for altering the vitreousness of a body, when the firing temperature is fixed. The effect of increasing the proportions (separately) of flint, stone, felspar, ball clay, and china clay in earthenware bodies. The introduction of lime.

6. *Glaze Making*.—(a) *Materials in general use*. Chemical composition, solubility in water and action of glost-oven heat on felspar, stone, flint, whiting, plaster of Paris, china clay, soda ash, soda crystals, boron compounds, pearlash, nitre, zinc oxide, barium compounds, litharge, red lead, white lead. Classification into acids, bases and salts.

(b) *Preparation*. Raw and fritted glazes. Methods of mixing and of fritting. Frit kilns. Glaze grinding. The

addition of raw flint, stone, etc., to the frit in making a finished glaze and devices used for keeping ground glaze in suspension.

7. *Glazes*.—Composition of glazes used for once fired and twice fired wares in this country. The broad practical considerations (fusibility, fluidity, etc.) governing their application and use. The different ways of applying glazes and smears to bodies. Salt glazing; chemical nature of salt-glaze, conditions necessary for success.

8. *Glost Firing*.—Wad clay. Methods of placing adopted in the glost firing of various wares. Principles to be observed in firing a glost oven or glazing kiln. General results of defective firing. Faults due to defective dipping.

9. General information on under-glaze colours, coloured glazes, coloured bodies and coloured slips. "Flow" colours. Colouring oxides—cobalt, nickel, copper, iron, manganese, chromium, titanium, uranium—chemical composition, physical properties. Colours obtained with the different types of glazes: alkaline or lead. Typical recipes. Methods of preparation.

The Examination in Grade II and the Final Examination will be held on Wednesday, May 1st, from 7 to 10. The fee for the Examination in either Grade is *One Shilling and Sixpence*.

### FINAL EXAMINATION.

1. The occurrence of clays in the British Isles. Different types of clay. General properties of clays. Chemical and physical properties of clays. Chemical and physical changes during the weathering of clays; plasticity and its causes. Artificial methods for increasing the plasticity of clays.

Mineralogical ("rational") and ultimate constitution of clays. The "rational" analysis of a clay and its value to the potter. Criticisms of the methods used for rational analysis. Calculation of rational analysis from analytical data. Synthesis of bodies from rational analyses. Methods of estimating the fineness of clays, &c. "Surface factors."

2. Ceramic calculations (a) given the chemical analysis to compute a molecular formula and conversely; (b) Compounding a recipe for raw and fritted glaze from the molecular formula, using pure and impure materials; (c) To represent a body or



glaze recipe as a molecular formula; (d) To replace one or more constituents in a recipe by a new substance of known composition. Use and abuse of molecular formulæ.

3. The general laws of the fusibility of mixtures. Methods of measuring refractory qualities. Eutectic mixtures. Acid, basic, and neutral refractory materials—ganister, chromite, dolomite, magnesite, and bauxite bricks. Saggars and refractory materials. Fireclays and sagger marls. Factors which determine the economical production and use of saggars and firebricks; influence of grog, fineness of particles, and porosity. Sagger machines—screw, hydraulic and steam presses.

4. *Hard Paste Porcelain*.—Its body, glaze, and the general methods of production.

*Soft Paste Porcelains*.—Parian and Jasper bodies. The respective qualities of these products for use and beauty of decoration.

5. English and Continental machines for preparing, grinding, and purifying potters' materials. Machines used in shaping pottery ware. Recent advances.

6. *Firing*.—The production of a reducing or oxidising atmosphere in an oven. The general effects of such varying conditions on (a) the bodies; (b) the glazes; (c) the colours. The defect called "sulphuring" and how it may be avoided. Treatment of under-glaze colours in the oven. Effect of different glazes on (a) under-glaze colours; (b) colouring oxides dissolved in the glaze. The firing of ovens and kilns by gas.

7. *Pyrometry*.—The various methods used by potters for determining the progress and termination of firing. Wedgwood's pyrometer. The principles involved in Fusion pyrometers of various forms, and their practical manufacture and use. The principles and methods of using electric resistance and thermocouple pyrometers. The temperature curves of ovens and kilns.

8. *Relations between Glaze and Body*.—"Crazing," "chipping" or "peeling." The cause and cure of such defects. Effects of the addition (separately or in conjunction) of silica, alumina, alkalis, lime, zinc oxide, lead oxide, and boric acid, to a glaze, with regard to fusibility, fluidity, colour, brilliance, permanence, crazing, &c. The reconstitution of a glaze from analytical data. The solubility of lead frits in dilute acid. Leadless glazes.

9. *On-the-glaze Colours*.—The colouring bases. The fluxes. Their preparation, composition and use. Conditions necessary to secure freshness and glossiness of the fired colours. Effects of overfire and underfire. The construction and management of kilns for enamelling. Recent advances, English and foreign.

10. *Metals*.—The preparation and use of gold, silver and platinum. Liquid gold, metallic lustres, ancient and modern.

11. Mechanical methods of decoration, including recent advances. Preparation of oils and varnishes for use with potters' colours.

**Viva Voce Test.**—Candidates for the Final Examination reaching a certain standard of proficiency at the Written Examination may be required to undergo a *viva voce* examination, with a view to determining the award of the Institute's prizes.

The *viva voce* examination will be held, on a date to be subsequently fixed, as soon as possible after the Written Examination.

**II. Full Technological Certificate.**—For the Full Technological Certificate, the candidate must qualify as stated in Rules 29 and 30, but Certificates showing that he has passed the Examinations of the Board of Education in Geometrical Drawing, as well as in Freehand or Model Drawing will be accepted in lieu of one of Science Certificates.

**III. Works of Reference.**—*For Grade I:* "Notes on the Manufacture of Earthenware" by Sandeman (Virtue & Co.); "The Clayworker's Handbook," (Charles Griffin & Co.). *For the Final Examination:*—"The Chemistry of Pottery," by Karl Langenbeck (Chemical Publishing Co., Easton, Pa.); "How to Analyse Clay" by Ashby (Scott, Greenwood and Co.); "Treatise on the Ceramic Industries" by Bourry (Scott, Greenwood & Co.); "High Temperature Measurements" by Le Chatelier (Chapman & Hall); "Seger's Collected Writings on the Manufacture of Pottery" (Scott, Greenwood & Co.); "Porcelain; its nature, art and manufacture" by Burton (Cassell & Co.); "Clays: their occurrence, properties and uses" by Heinrich Ries (London—Chapman and Hall, Ltd.); "The Proceedings of the English Ceramic Society."

## 16.—GLASS MANUFACTURE.

With a view to encouraging apprentices to take a continuous course of instruction in this subject, the Examination will be divided into three Grades, of which Grade I will be of an elementary character. No Certificates will be awarded on the results of the Examination in Grade I, but the Candidates' successes will be notified to the Centres at which they were examined.

Candidates may enter for the Examination in Grade II without having previously passed in Grade I, but Candidates for the Final Examination must hold a Certificate in Grade II. Both the Examination in Grade II and the Final Examination will include a practical chemical test.

I. Syllabus.—The Examinations will include questions founded on the following subjects :—

#### GRADE I.

##### (1.) Written Examination.

1. The materials used in the manufacture of "Flint" glass, and of Sheet glass.
2. The physical properties of glass of importance in its manufacture.
3. Receptacles in which glass is melted.
4. Glass furnaces.
5. Tools used in making tumblers, wine-glasses, &c., by hand.
6. The manufacture by hand of tumblers, wine-glasses and simple objects, with illustrative diagrams.
7. The manufacture of sheet-glass.
8. The manufacture of plate-glass (in the rough).
9. The manufacture of pressed glass.
10. The manufacture of tube (plain).
11. The manufacture of moulded bottles, with diagrams.
12. The various uses of dip moulds.
13. The principle of the process of annealing.
14. Elementary chemistry of glass-forming substances.

(2.) Drawing.—Full-sized drawings of simple objects, preferably in glass, using the measuring tools used in the glass-house, viz., foot-rule, calipers, measure-stick and chalk.

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The Examination in Grade I will be held on Monday, April 29th, from 7 to 10 p.m. The fee for the Examination is *One Shilling and Sixpence*.

#### GRADE II.

(1.) Written Examination.—In addition to more advanced questions on the subjects covered by the syllabus for Grade I, questions may be set on the following :—

1. The chemical constituents of Flint and sheet glass.
2. The chemical reactions which occur when the materials used in making the above glasses are mixed and subjected to great heat.
3. The origin of the materials used in the manufacture of glass, and the commercial preparation of the same.

4. Methods of testing the purity of materials used in glass-making, including fire-clay.

5. Elementary chemistry of combustion. Solid, liquid and gaseous fuel. Products of combustion. Principle of the gas producer.

6. The process of drawing tube for the manufacture of thermometers, with illustrative diagrams.

7. The processes of cutting and engraving hollow-ware, with illustrative diagrams.

(2.) Drawing.—Drawing simple objects to a given scale, using measuring implements described in syllabus for Grade I.

(3.) Practical Test.—Qualitative analysis of simple salts.

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#### FINAL EXAMINATION.

*Candidates for the Final Examination must hold a Certificate in Grade I.*

(1.) Written Examination.—In addition to the subjects of the previous Grades, a knowledge will be expected of the following:—

1. Chemical calculations of the percentage composition of glass mixtures, and of the glass-forming oxides contained in raw materials.

2. *Combustion and Fuel*.—Coal, its proximate composition and suitability for various purposes in glass making. Various types of gas-producers. The chemical analysis of producer gas. Calorific value of coal and of producer gas, methods of determining calorific values. Temperatures obtained by combustion of various fuels. Oxidising and reducing flames. Economy of complete combustion. Products of combustion. Analysis of flue gases. Principle of the regenerative gas furnace.

3. *Pyrometry*.—Measurement of high temperatures. Limits of usefulness of the mercury thermometer. Heat indicators—Seger Cones and Watkin Recorders. Electric pyrometers, thermo-electric, resistance and recording. Radiation pyrometers, the Wanner and the Féry pyrometers. The ranges of temperature involved in various operations of glass manufacture.

4. The processes of smoothing and polishing plate glass.

5. The process of etching on glass.

6. The construction of moulds for blown glass, and of moulds, plungers, and presses for pressed glass.

7. Methods by which the cost of the manufacture of table-ware may be reduced.

8. Special glasses for scientific and other purposes.

9. Coloured glasses.

10. Recent developments in the application of heat, the chemistry of glass making and the manufacture and decoration of glass.

11. History of glass-making in England.

12. Knowledge of the procedure to be followed in the qualitative and quantitative analyses of glasses and clays.

(2.) Drawing.—Drawing, to given scale, objects with handles, spouts, etc., using measuring implements previously described.

(3.) Practical Test.—Qualitative and quantitative analyses of simple salts and materials used in glass-manufacture (clay excluded).

*Drawing paper is supplied by the Institute, but all instruments, pencils, or other materials required must be provided by the Candidates or the School.*

The Examination in Grade II and the Final Examination, written, drawing and practical, will be held on Wednesday, May 1st, 7 to 10 p.m. The fee for the complete Examination in either Grade is *Two Shillings and Sixpence*.

II. Full Technological Certificate.—For the Full Technological Certificate, the Candidate must qualify as stated in Rules 29 and 30, but certificates showing that he has passed the Examinations of the Board of Education in Geometrical Drawing, as well as in Freehand or Model Drawing will be accepted in lieu of one of the Science Certificates.

III. Works of Reference.—“Glass Manufacture,” by W. Rosenhain (Constable—Westminster Series); “Some Properties of Glass,” by W. Rosenhain, (Transactions of the Optical Society, London, June 15th, 1903); “La Verrerie au XX<sup>e</sup>. Siècle,” by Jules Henrivaux (Paris, R. Bernard et Cie., 1903); “Die Glasfabrikation,” by R. Gerner (A. Hartleben’s Verlag, Vienna and Leipzig, 1897); “Die Bearbeitung von Glaskörpern,” by C. Wetzel (A. Hartleben’s Verlag, Vienna and Leipzig, 1901); “Die Herstellung grosser Glaskörper,” by C. Wetzel (A. Hartleben’s Verlag, Vienna and Leipzig, 1900); “Glasfabriken und Hohlglasfabrikation,” by R. Dralle (Leipzig, Baumgärtner, 1886); “Die Glasfabrikation,” by Dr. E. Tscheuschner (Weimar, B. H. Voigt, 1888); “High Temperature Measurements,” by Le Chatelier, Boudouard and Burgess. Students should refer also to the catalogues of various instrument makers, such as the Cambridge Scientific Instrument Co., Messrs. Baird and Tatlock, and Messrs. J. J. Griffin and Son; “The Principles of Glass Making” (Geo. Bell & Sons); “Glass,” Supplement to IXth Edition Encyclopædia Britannica; “Guide du Verrier” (G. Bontemps, Paris); “Le Verre et le Cristal,” J. Henrivaux (P. Vicq-Dunod et Cie., Paris); “Verres et Emaux,” L. Coffignal (Baillièrre et Fils, Paris); Hovestadt’s “Jena Glass,” translated by J. D. and A. Everett (Macmillan); Glazebrook’s Cantor Lectures (1902) on “Glass for Optical Purposes” (Society of Arts). For the history of glass-making in England—“Old English Glasses,” by Albert Hartshorne (Edward Arnold, 1897).

## 17.—DRESSING OF SKINS AND MANUFACTURE OF LIGHT LEATHERS.

The knowledge required in Grade I will be mainly practical, and such as may be expected from an intelligent workman. As many varieties of skins and methods of tanning come under this heading, it is not expected that Candidates for the Examination in Grade I shall be acquainted with details outside their own branch ; they are, however, expected to understand the principles applied in the manufacture of all kinds of light leather. In the Final Examination accurate scientific information and the power of applying it to technical purposes will be expected.

**I. Syllabus.**—The Examination will include questions founded on such subjects as the following :—

### GRADE I.

1. *Skins*.—Description and origin of the principal skins used in leather dressing, including calf, goat, kid, sheep, &c., in the fresh, dry, and salted condition.

Outlines of the anatomical structure and chemical composition of skin.

2. *Preparatory processes*.—Washing, soaking, and softening. Unhairing by “sweating” and other putrefactive methods, liming, the use of caustic alkalies and alkaline sulphides, and the effect of these agents on the constituents of the skin. Fleshing, splitting, and scudding, and the tools and machines employed for these processes. Washing, bateing, and drenching, and their effects on the skin. Salting and pickling of skins for export.

3. *Theory of the Tanning process*.—General outline of producing leather by the use of mineral salts, especially those of alumina and chromium, of fish oils, and of the different vegetable tanning materials.

4. *Materials employed*.—In chamoising, tawing, and tanning. Various kinds of fish oils used, alum and sulphate of alumina, bichromate of potash, chrome alum, common salt. Vegetable tanning materials, their characteristics and effects. Sumach, myrobalans, gambier, cutch, quebracho, oak, larch, and mimosa barks, and the various extracts derived from these and their woods. Valonia. Structure of barks and woods.

Mills and machinery for preparing tanning materials for use. Extraction and preparation of tanning liquors. Leaches. Use of extracts. Use of the “barkometer.”

5. *Tanning*.—Practical details of the methods in use for sheep, goat, and calf tanning. Paddles, drums, and other appliances used in tanning. Time and strength of liquor in the various stages of the tanning process, and the selection of appropriate tanning materials.

6. *Drying of Leather*.—Construction of sheds and drying rooms and the various methods of heating and ventilating the same. Drying of crust goods, and of dyed and finished leather. Degreasing.

7. *Finishing*.—Outlines of the finishing process. Preparation for dyeing. Dyeing, striking out, seasoning, and glazing, and machinery employed in these processes. Bleaching of leather.

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### FINAL EXAMINATION.

In the Final Examination more difficult questions will be set in the above subjects, and, in addition, a knowledge will be required of:—

1. Additional varieties of skins, such as pig, seal, kangaroo, lizard, snake, alligator, &c. The dressing or curing of mat skins and furs. New and improved methods of tanning, and some acquaintance with the latest scientific literature of the subject.

2. The details of the chemistry and minute anatomy of skins and the various chemical agents which have been used in modern times for unhairing, puring and depleting.

3. Chemical characteristics and classification of tannins. Estimation of tannins by the hide-powder method, and with permanganate and indigo. Simple applications of volumetric analysis in tanning; analysis of leathers. Detection of adulterants.

4. Construction and arrangement of tanneries, with the necessary machinery. Calculation of the cost of tannage and valuation of liquors.

5. By-products and utilization of refuse, wool, hair, glue stuff, and spent tan. Manure and treatment of sewage.

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The Examination in both grades will be held on Wednesday, May 1st, 7 to 10 p.m. The fee for the Examination in either Grade is *One Shilling*.

II. *Full Technological Certificate*.—For the Full Technological Certificate, the candidate must qualify as stated in Rules 29 and 30.

III. *Works of Reference*.—H. R. Procter, "Leather Industries Laboratory Book" (Spon), 1898. "Principles of Leather Manufacture," by Procter (Spon), 1903. C. T. Davis, "Manufacture of Leather" (Sampson Low), 1897. S. R. Trotman, "Leather Trades Chemistry" (Griffin). Bennett, "Leather Manufacture" (Constable). J. W. Stevens, "Leather Manufacture" (Sampson Low), 1891. M. C. Lamb, "Leather Dressing and Dyeing" (Leather Trades Publishing Company), 1907. Articles, "Leather," in Chambers' Encyclopædia; "Tannins," in A. H. Allen's "Commercial Organic Analysis" (Churchill); "Leather," in "Dictionary of

Applied Chemistry" (Longmans), 1890; "Leather for Libraries" (Library Supply Co.); "Abridgments of Specifications, Skins, Hides, and Leather, 1627-1880," H. Trimble; "The Tannins" (Lippincott, Philadelphia, 1892).

## 18.—TANNING OF HIDES AND DRESSING OF HEAVY LEATHER.

I. *Syllabus*.—The knowledge required in Grade I will be mainly practical, and such as may be expected from an intelligent workman; while in the Final Examination, accurate scientific information, and the power of applying it to technical purposes, will be expected. The examination will include questions founded on such subjects as the following:—

### GRADE I.

1. *Hides and Skins*.—Description and origin of the principal hides used in tanning. Ox and cow hides, fresh, salted, drysalted, and dry, kips and buffalo hides, calf skins, &c.

Outlines of the anatomical structure and chemical composition of skin and its products.

2. *Treatment preparatory to Tanning*.—Washing, soaking, and softening. Unhairing by "sweating" and other putrefactive methods, liming, and the use of caustic alkalies and alkaline sulphides, and the effect of these agents on the constituents of the skin. Washing and the effect of bates and drenches in removing lime and softening the pelt. Simple chemical methods of deliming. Fleshing, splitting, and scudding, and the tools and machines employed for these processes.

3. *Theory of the Tanning process*.—General outlines of the methods of producing leather by the use of mineral salts, especially those of alumina, of oils and fats, and of the different vegetable tanning materials.

4. *Materials employed in Tawing and Tanning*.—Alum and sulphate of alumina, chrome salts, hyposulphite of soda, common salt, oils and fats. Vegetable tanning materials, their characteristics and effects. Oak bark, valonia, myrobalans, sumach, galls, divi-divi, canaigre; mimosa, larch and hemlock bark, oak, quebracho, and chestnut woods and their extracts, gambier, cutch, &c. Structure of barks and woods.

Mills and other machinery for preparing tanning materials for use. Extraction and preparation of tanning liquors. Concentrated extracts and their dilution for use in tanning. Use of the "barkometer."

5. *Tanning*.—Practical details of the methods in use for sole and belt-butts, shaved and dressing hides, kips, and skins. Appliances colouring and graining, appliances for suspending and for moving goods in the liquors; handling and the arrangements of shifts and



liquors ; dusting, and laying away, washing up for the shed. Time, and strength of liquor in the various stages of the tanning process, and the selection of appropriate tanning materials.

6. *Drying of Leather*.—Construction of sheds and drying rooms and the various methods of heating and ventilating the same. Drying of rough leather, dressing and shaved hides, and of curried goods.

7. *Finishing of Sole-leather*.—Striking, scouring, and rolling, and the various machines employed for these purposes, and the stains and seasonings used.

8. *Currying*.—Its general principles and the materials used ; oils, tallows, and degreas, and various substitutes. Glucose and other weighting materials. The use of the stuffing drum. Outlines of the methods in use in currying belting, hydraulic, and harness leather kips, and calf-skins, and the machinery employed.

9. *Utilization of Refuse*.—Hair, horns, glue-stuff, wool, and spent tan. Manure and the treatment of sewage.

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#### FINAL EXAMINATION.

In the Final Examination more difficult questions will be set in the above subjects, and in addition a knowledge will be required of :—

1. The details of the chemistry and minute anatomy of hides and skins, and the various chemical agents which have been used in modern times for unhairing, puring, and depleting.

2. Chemical characteristics and classification of tannins. Estimation of tannins by hide-powder, and with permanganate and indigo. Testing acidity of liquors and other simple applications of volumetric analysis in tanning. The chemistry and analysis of chrome and alum liquors, and of the commoner fats and oils. Analysis of leather.

3. Construction and arrangement of tanneries, with the necessary machinery. Calculation of cost of tannage and valuation of liquors.

4. Chemical analysis for the control of the tanning process.

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The Examination in both grades will be held on Wednesday, May 1st, 7 to 10 p.m. The fee for the Examination in either Grade is *One Shilling*.

II. *Full Technological Certificate*.—For the Full Technological Certificate, the candidate must qualify as stated in Rules 29 and 30.

III. *Works of Reference*.—Articles "Leather" in "Encyclopædia Britannica," in "Chemistry as applied to the Arts and Sciences" (MacKenzie); and in "Dictionary of Applied Chemistry" (Longmans), 1890. "Der Gerber" (pub. bi-monthly, Vienna). Stevens' "Leather Manufacture" (Sampson Low), 1891. "The Leather Trades Review" (Mark Lane, E.C.). *See also List under Subject 17.*

## 19.—BOOT AND SHOE MANUFACTURE.

The course of instruction is intended to cover at least three years.

The Examinations will be held in four grades, of which Grade I will be optional.

The Examination in Grade I will consist of Written and Practical Tests in the following Branches, and a candidate may pass by satisfying the Examiners in any one Branch, Written and Practical : 1. Pattern Cutting and Last Fitting. 2. Clicking. 3. Closing. 4. Sole Leather Cutting. 5. Bottoming (Lasting and Attaching). 6. Finishing. The standard expected in this Examination is such as may be attained by a youth after one year's attendance at a Technical School.

The Examination in Grade II will consist of — (1) Simple questions on the scientific principles underlying Boot and Shoe Manufacture, and their application to Workshop Practice, and (2) Simple practical tests. Both parts must be taken in the same year.

No Certificates will be awarded on the results of the Examination in either Grade I or Grade II, but the successes of Candidates will be communicated to the centres where they were examined.

The Examination in Grade III will consist of a Written Examination and a Practical Test obligatory on all Candidates to be taken in *one branch* only. Candidates will not be admitted to the Practical Test alone. Pass Certificates only will be awarded on the results of this Examination.

The Final Examination will consist of a Written Examination and a Practical Test; Candidates for the Final Examination in any one Section must have previously passed in the same Section of Grade III.

The results of the Practical Examinations will be taken into consideration in determining the successes of the Candidates, in the award of prizes, and of first and second class Certificates in the Final Examination.

To obtain a Certificate in Grade III or the Final Examination, Candidates must pass in the Written and Practical parts of the Examinations in the same year. The Certificate will state the branch of the Trade in which the Candidate has passed the Practical Test.

In order that facilities may be given to students to qualify themselves for Certificates in more than one branch of the subject of Boot and Shoe Manufacture, a candidate who has already obtained a Certificate in one section of Grade III, or Certificates in the same section of both Grade III and the Final Examination, is permitted to present himself again in Grade III with a view to qualifying for a Certificate in another section: those

Branches which comprise both hand and machine methods will be considered as comprising two distinct Sections so far as regards the Practical Test. Candidates taking a second section under this regulation must present themselves for both parts of the examination, Written and Practical.

A Candidate, who has already obtained a Prize in either Grade, will not be eligible for another Prize in the same Grade, and a candidate who has passed the Final Examination in any section will not be eligible for a Prize in any section of Grade III.

The Practical Tests will be held at all centres at which a sufficient number of Candidates present themselves, and at which the Institute's Examiner can attend. They will be held as soon after the Written Examination as possible, on dates to be subsequently fixed. *Candidates must state the branch in which they desire to submit themselves for the Practical Test.*

At the Written Examinations in all grades Candidates may make use of ordinary drawing instruments, including ordinary scales graduated in inches or in centimetres, but are not permitted to bring with them any notes, specially graduated rules or tools; the only miniature marking patterns that may be used are the following:—insole shape, last and forme shapes, vamp quarter, standard and sole, stiffener and top-piece patterns. The patterns so used must be pinned to the Candidate's answer-paper.

## I. Syllabus.—

### GRADE I (OPTIONAL).

(1.) **Written Examination.**—Candidates will be required to pass in one of the following sections.

1. **Pattern Cutting and Last Fitting.** Locating positions of measurements on lasts; determination of pitch and spring. Various methods of Forme Cutting; comparison of results. Cutting insole patterns to lasts. The use of construction lines, and meaning of spring, pitch, inclination, draft, &c., as applied to patterns.

Standard construction for boots and shoes of plain design. Principles and methods of proportional grading.

Last Fitting. Measuring apparatus. Various fittings and their effects on measurement and shape.

Taking and recording measures.

2. **Clicking.** The various leathers used for uppers; structure of leather. How skins are converted into leather; general characteristics of the leathers produced by the different methods. Hides and skins; their shapes and divisions. Characteristics of the various parts and utilization in different parts of the upper. Systematic arrangements of patterns for fabrics and leathers and how these arrangements are affected according to size and shape of patterns and material.

3. Closing. Preparing the various parts of the upper for closing. The various seams and edges used. Fitting the parts together by different methods. Order of processes, and the machines used. The various kinds of needles and threads and their relation to each other.

4. Sole Leather Cutting. Hides used for bottoming leathers ; where obtained. Elementary knowledge of the tanning of sole leathers ; how the hide is divided ; principal tanning agents used and leathers produced. Chief features of the different leathers and their suitability for certain purposes. Methods of cutting bottoming leathers ; ranging and cutting direct. Wetting and rolling ; the effect of hard and soft water. Bottom stock preparation.

5. Bottoming Lasting and Attaching. Principles of lasting ; methods of drafting ; the various strains and pulls required ; effect of strains in different directions. Comparison of hand and machine processes. Various methods of attachment and principles underlying their application ; machines used and seams produced. Bottom levelling by hand and machine. Heel building and attaching by hand and machine. Shapes and heights of heels.

6. Finishing. Principles and objects of finishing. Shaping and smoothing heels and edges ; comparison of hand and machine methods ; description of cutters and irons used. Treatment of the bottoms. The various styles of finish and their effect of their appearance upon the boot.

(2.) **Practical Examination.**—The Examination will consist of simple Practical tests in the various sections.

The Written Examination in Grade I will be held on **Monday, April 29th**, from 7 to 10 p.m. The fee for the entire Examination, Written and Practical, is *Two Shillings and Sixpence*.

## GRADE II.

(1.) **Written Examination.**—Candidates will be required to qualify in both Section I and II, but a thorough knowledge of division (a) or (b) of Section II will enable a candidate to qualify in that Section.

## SECTION I.

1. Elementary problems in geometry ; use of protractor and set squares. Proportion ; division of lines ; proportional triangles. Fractions ; decimals ; percentages. Measurement of areas (as of skins and patterns).

2. The external form of the foot and how it is determined by the internal structure.

Branches which comprise both hand and machine methods will be considered as comprising two distinct Sections so far as regards the Practical Test. Candidates taking a second section under this regulation must present themselves for both parts of the examination, Written and Practical.

A Candidate, who has already obtained a Prize in either Grade, will not be eligible for another Prize in the same Grade, and a candidate who has passed the Final Examination in any section will not be eligible for a Prize in any section of Grade III.

The Practical Tests will be held at all centres at which a sufficient number of Candidates present themselves, and at which the Institute's Examiner can attend. They will be held as soon after the Written Examination as possible, on dates to be subsequently fixed. *Candidates must state the branch in which they desire to submit themselves for the Practical Test.*

At the Written Examinations in all grades Candidates may make use of ordinary drawing instruments, including ordinary scales graduated in inches or in centimetres, but are not permitted to bring with them any notes, specially graduated rules or tools; the only miniature marking patterns that may be used are the following:—insole shape, last and forme shapes, vamp quarter, standard and sole, stiffener and top-piece patterns. The patterns so used must be pinned to the Candidate's answer-paper.

## I. Syllabus.—

### GRADE I (OPTIONAL).

(1.) **Written Examination.**—Candidates will be required to pass in one of the following sections.

1. **Pattern Cutting and Last Fitting.** Locating positions of measurements on lasts; determination of pitch and spring. Various methods of Forme Cutting; comparison of results. Cutting insole patterns to lasts. The use of construction lines, and meaning of spring, pitch, inclination, draft, &c., as applied to patterns.

Standard construction for boots and shoes of plain design. Principles and methods of proportional grading.

Last Fitting. Measuring apparatus. Various fittings and their effects on measurement and shape.

Taking and recording measures.

2. **Clicking.** The various leathers used for uppers; structure of leather. How skins are converted into leather; general characteristics of the leathers produced by the different methods. Hides and skins; their shapes and divisions. Characteristics of the various parts and utilization in different parts of the upper. Systematic arrangements of patterns for fabrics and leathers and how these arrangements are affected according to size and shape of patterns and material.

3. Closing. Preparing the various parts of the upper for closing. The various seams and edges used. Fitting the parts together by different methods. Order of processes, and the machines used. The various kinds of needles and threads and their relation to each other.

4. Sole Leather Cutting. Hides used for bottoming leathers; where obtained. Elementary knowledge of the tanning of sole leathers; how the hide is divided; principal tanning agents used and leathers produced. Chief features of the different leathers and their suitability for certain purposes. Methods of cutting bottoming leathers; ranging and cutting direct. Wetting and rolling; the effect of hard and soft water. Bottom stock preparation.

5. Bottoming Lasting and Attaching. Principles of lasting; methods of drafting; the various strains and pulls required; effect of strains in different directions. Comparison of hand and machine processes. Various methods of attachment and principles underlying their application; machines used and seams produced. Bottom levelling by hand and machine. Heel building and attaching by hand and machine. Shapes and heights of heels.

6. Finishing. Principles and objects of finishing. Shaping and smoothing heels and edges; comparison of hand and machine methods; description of cutters and irons used. Treatment of the bottoms. The various styles of finish and their effect of their appearance upon the boot.

(2.) **Practical Examination.**—The Examination will consist of simple Practical tests in the various sections.

The Written Examination in Grade I will be held on **Monday, April 29th**, from 7 to 10 p.m. The fee for the entire Examination, Written and Practical, is *Two Shillings and Sixpence*.

## GRADE II.

(1.) **Written Examination.**—Candidates will be required to qualify in both Section I and II, but a thorough knowledge of division (a) or (b) of Section II will enable a candidate to qualify in that Section.

## SECTION I.

1. Elementary problems in geometry; use of protractor and set squares. Proportion; division of lines; proportional triangles. Fractions; decimals; percentages. Measurement of areas (as of skins and patterns).

2. The external form of the foot and how it is determined by the internal structure.

6. *Drying of Leather.*—Construction of sheds and drying rooms and the various methods of heating and ventilating the same. Drying of crust goods, and of dyed and finished leather. Degreasing.

7. *Finishing.*—Outlines of the finishing process. Preparation for dyeing. Dyeing, striking out, seasoning, and glazing, and machinery employed in these processes. Bleaching of leather.

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### FINAL EXAMINATION.

In the Final Examination more difficult questions will be set in the above subjects, and, in addition, a knowledge will be required of:—

1. Additional varieties of skins, such as pig, seal, kangaroo, lizard, snake, alligator, &c. The dressing or curing of mat skins and furs. New and improved methods of tanning, and some acquaintance with the latest scientific literature of the subject.

2. The details of the chemistry and minute anatomy of skins and the various chemical agents which have been used in modern times for unhairing, puring and depleting.

3. Chemical characteristics and classification of tannins. Estimation of tannins by the hide-powder method, and with permanganate and indigo. Simple applications of volumetric analysis in tanning; analysis of leathers. Detection of adulterants.

4. Construction and arrangement of tanneries, with the necessary machinery. Calculation of the cost of tannage and valuation of liquors.

5. By-products and utilization of refuse, wool, hair, glue stuff, and spent tan. Manure and treatment of sewage.

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The Examination in both grades will be held on Wednesday, May 1st, 7 to 10 p.m. The fee for the Examination in either Grade is *One Shilling*.

II. *Full Technological Certificate.*—For the Full Technological Certificate, the candidate must qualify as stated in Rules 29 and 30.

III. *Works of Reference.*—H. R. Procter, "Leather Industries Laboratory Book" (Spon), 1898. "Principles of Leather Manufacture," by Procter (Spon), 1903. C. T. Davis, "Manufacture of Leather" (Sampson Low), 1897. S. R. Trotman, "Leather Trades Chemistry" (Griffin). Bennett, "Leather Manufacture" (Constable). J. W. Stevens, "Leather Manufacture" (Sampson Low), 1891. M. C. Lamb, "Leather Dressing and Dyeing" (Leather Trades Publishing Company), 1907. Articles, "Leather," in Chambers' Encyclopædia; "Tannins," in A. H. Allen's "Commercial Organic Analysis" (Churchill); "Leather," in "Dictionary of

Applied Chemistry" (Longmans), 1890; "Leather for Libraries" (Library Supply Co.); "Abridgments of Specifications, Skins, Hides, and Leather, 1627-1880," H. Trimble; "The Tannins" (Lippincott, Philadelphia, 1892).

## 18.—TANNING OF HIDES AND DRESSING OF HEAVY LEATHER.

**I. Syllabus.**—The knowledge required in Grade I will be mainly practical, and such as may be expected from an intelligent workman; while in the Final Examination, accurate scientific information, and the power of applying it to technical purposes, will be expected. The examination will include questions founded on such subjects as the following:—

### GRADE I.

1. *Hides and Skins.*—Description and origin of the principal hides used in tanning. Ox and cow hides, fresh, salted, drysalted, and dry, kips and buffalo hides, calf skins, &c.

Outlines of the anatomical structure and chemical composition of skin and its products.

2. *Treatment preparatory to Tanning.*—Washing, soaking, and softening. Unhairing by "sweating" and other putrefactive methods, liming, and the use of caustic alkalies and alkaline sulphides, and the effect of these agents on the constituents of the skin. Washing and the effect of bates and drenches in removing lime and softening the pelt. Simple chemical methods of deliming. Fleshing, splitting, and scudding, and the tools and machines employed for these processes.

3. *Theory of the Tanning process.*—General outlines of the methods of producing leather by the use of mineral salts, especially those of alumina, of oils and fats, and of the different vegetable tanning materials.

4. *Materials employed in Tawing and Tanning.*—Alum and sulphate of alumina, chrome salts, hyposulphite of soda, common salt, oils and fats. Vegetable tanning materials, their characteristics and effects. Oak bark, valonia, myrobalans, sumach, galls, divi-divi, canaigre; mimosa, larch and hemlock bark, oak, quebracho, and chestnut woods and their extracts, gambier, cutch, &c. Structure of barks and woods.

Mills and other machinery for preparing tanning materials for use. Extraction and preparation of tanning liquors. Concentrated extracts and their dilution for use in tanning. Use of the "barkometer."

5. *Tanning.*—Practical details of the methods in use for sole and belt-butts, shaved and dressing hides, kips, and skins. Appliances colouring and graining, appliances for suspending and for moving goods in the liquors; handling and the arrangements of shifts and



liquors ; dusting, and laying away, washing up for the shed. Time, and strength of liquor in the various stages of the tanning process, and the selection of appropriate tanning materials.

6. *Drying of Leather*.—Construction of sheds and drying rooms and the various methods of heating and ventilating the same. Drying of rough leather, dressing and shaved hides, and of curried goods.

7. *Finishing of Sole-leather*.—Striking, scouring, and rolling, and the various machines employed for these purposes, and the stains and seasonings used.

8. *Currying*.—Its general principles and the materials used ; oils, tallows, and degreas, and various substitutes. Glucose and other weighting materials. The use of the stuffing drum. Outlines of the methods in use in currying belting, hydraulic, and harness leather kips, and calf-skins, and the machinery employed.

9. *Utilization of Refuse*.—Hair, horns, glue-stuff, wool, and spent tan. Manure and the treatment of sewage.

### FINAL EXAMINATION.

In the Final Examination more difficult questions will be set in the above subjects, and in addition a knowledge will be required of :—

1. The details of the chemistry and minute anatomy of hides and skins, and the various chemical agents which have been used in modern times for unhairing, puring, and depleting.

2. Chemical characteristics and classification of tannins. Estimation of tannins by hide-powder, and with permanganate and indigo. Testing acidity of liquors and other simple applications of volumetric analysis in tanning. The chemistry and analysis of chrome and alum liquors, and of the commoner fats and oils. Analysis of leather.

3. Construction and arrangement of tanneries, with the necessary machinery. Calculation of cost of tannage and valuation of liquors.

4. Chemical analysis for the control of the tanning process.

The Examination in both grades will be held on Wednesday, May 1st, 7 to 10 p.m. The fee for the Examination in either Grade is *One Shilling*.

II. *Full Technological Certificate*.—For the Full Technological Certificate, the candidate must qualify as stated in Rules 29 and 30.

III. *Works of Reference*.—Articles "Leather" in "Encyclopædia Britannica," in "Chemistry as applied to the Arts and Sciences" (MacKenzie) ; and in "Dictionary of Applied Chemistry" (Longmans), 1890. "Der Gerber" (pub. bi-monthly, Vienna). Stevens' "Leather Manufacture" (Sampson Low), 1891. "The Leather Trades Review" (Mark Lane, E.C.). See also *List under Subject 17*.

## 19.—BOOT AND SHOE MANUFACTURE.

The course of instruction is intended to cover at least three years.

The Examinations will be held in four grades, of which Grade I will be optional.

The Examination in Grade I will consist of Written and Practical Tests in the following Branches, and a candidate may pass by satisfying the Examiners in any one Branch, Written and Practical : 1. Pattern Cutting and Last Fitting. 2. Clicking. 3. Closing. 4. Sole Leather Cutting. 5. Bottoming (Lasting and Attaching). 6. Finishing. The standard expected in this Examination is such as may be attained by a youth after one year's attendance at a Technical School.

The Examination in Grade II will consist of—(1) Simple questions on the scientific principles underlying Boot and Shoe Manufacture, and their application to Workshop Practice, and (2) Simple practical tests. Both parts must be taken in the same year.

No Certificates will be awarded on the results of the Examination in either Grade I or Grade II, but the successes of Candidates will be communicated to the centres where they were examined.

The Examination in Grade III will consist of a Written Examination and a Practical Test obligatory on all Candidates to be taken in *one branch* only. Candidates will not be admitted to the Practical Test alone. Pass Certificates only will be awarded on the results of this Examination.

The Final Examination will consist of a Written Examination and a Practical Test; Candidates for the Final Examination in any one Section must have previously passed in the same Section of Grade III.

The results of the Practical Examinations will be taken into consideration in determining the successes of the Candidates, in the award of prizes, and of first and second class Certificates in the Final Examination.

To obtain a Certificate in Grade III or the Final Examination, Candidates must pass in the Written and Practical parts of the Examinations in the same year. The Certificate will state the branch of the Trade in which the Candidate has passed the Practical Test.

In order that facilities may be given to students to qualify themselves for Certificates in more than one branch of the subject of Boot and Shoe Manufacture, a candidate who has already obtained a Certificate in one section of Grade III, or Certificates in the same section of both Grade III and the Final Examination, is permitted to present himself again in Grade III with a view to qualifying for a Certificate in another section: those

Branches which comprise both hand and machine methods will be considered as comprising two distinct Sections so far as regards the Practical Test. Candidates taking a second section under this regulation must present themselves for both parts of the examination, Written and Practical.

A Candidate, who has already obtained a Prize in either Grade, will not be eligible for another Prize in the same Grade, and a candidate who has passed the Final Examination in any section will not be eligible for a Prize in any section of Grade III.

The Practical Tests will be held at all centres at which a sufficient number of Candidates present themselves, and at which the Institute's Examiner can attend. They will be held as soon after the Written Examination as possible, on dates to be subsequently fixed. *Candidates must state the branch in which they desire to submit themselves for the Practical Test.*

At the Written Examinations in all grades Candidates may make use of ordinary drawing instruments, including ordinary scales graduated in inches or in centimetres, but are not permitted to bring with them any notes, specially graduated rules or tools; the only miniature marking patterns that may be used are the following:—insole shape, last and forme shapes, vamp quarter, standard and sole, stiffener and top-piece patterns. The patterns so used must be pinned to the Candidate's answer-paper.

#### I. Syllabus.—

##### GRADE I (OPTIONAL).

(1.) **Written Examination.**—Candidates will be required to pass in one of the following sections.

1. **Pattern Cutting and Last Fitting.** Locating positions of measurements on lasts; determination of pitch and spring. Various methods of Forme Cutting; comparison of results. Cutting insole patterns to lasts. The use of construction lines, and meaning of spring, pitch, inclination, draft, &c., as applied to patterns.

Standard construction for boots and shoes of plain design. Principles and methods of proportional grading.

Last Fitting. Measuring apparatus. Various fittings and their effects on measurement and shape.

Taking and recording measures.

2. **Clicking.** The various leathers used for uppers; structure of leather. How skins are converted into leather; general characteristics of the leathers produced by the different methods. Hides and skins; their shapes and divisions. Characteristics of the various parts and utilization in different parts of the upper. Systematic arrangements of patterns for fabrics and leathers and how these arrangements are affected according to size and shape of patterns and material.

3. Closing. Preparing the various parts of the upper for closing. The various seams and edges used. Fitting the parts together by different methods. Order of processes, and the machines used. The various kinds of needles and threads and their relation to each other.

4. Sole Leather Cutting. Hides used for bottoming leathers ; where obtained. Elementary knowledge of the tanning of sole leathers ; how the hide is divided ; principal tanning agents used and leathers produced. Chief features of the different leathers and their suitability for certain purposes. Methods of cutting bottoming leathers ; ranging and cutting direct. Wetting and rolling ; the effect of hard and soft water. Bottom stock preparation.

5. Bottoming Lasting and Attaching. Principles of lasting ; methods of drafting ; the various strains and pulls required ; effect of strains in different directions. Comparison of hand and machine processes. Various methods of attachment and principles underlying their application ; machines used and seams produced. Bottom levelling by hand and machine. Heel building and attaching by hand and machine. Shapes and heights of heels.

6. Finishing. Principles and objects of finishing. Shaping and smoothing heels and edges ; comparison of hand and machine methods ; description of cutters and irons used. Treatment of the bottoms. The various styles of finish and their effect of their appearance upon the boot.

(2.) Practical Examination.—The Examination will consist of simple Practical tests in the various sections.

The Written Examination in Grade I will be held on Monday, April 29th, from 7 to 10 p.m. The fee for the entire Examination, Written and Practical, is *Two Shillings and Sixpence*.

## GRADE II.

(1.) Written Examination.—Candidates will be required to qualify in both Section I and II, but a thorough knowledge of division (a) or (b) of Section II will enable a candidate to qualify in that Section.

### SECTION I.

1. Elementary problems in geometry ; use of protractor and set squares. Proportion ; division of lines ; proportional triangles. Fractions ; decimals ; percentages. Measurement of areas (as of skins and patterns).

2. The external form of the foot and how it is determined by the internal structure.

## SECTION II.

## (a) UPPERS :—

1. Pattern Cutting. Locating positions of measurements on lasts. Various methods of *forme* cutting. Cutting insole patterns to last. Allowances for seams and lasting over. Use of construction lines, and meaning of pitch, spring, leg-position, &c. Standard construction, grading and last fitting.

2. Upper leathers. The shape of skins and hides ; well-shaped and badly-shaped skins. Relative quality, substance, and stretch of the various parts. Requirements of the upper with regard to substance, quality, and stretch. Methods and principles of cutting linings and fabrics.

3. Preparing the various parts for closing ; seams and edges used. Fitting the parts together. Adhesives. Sewing machines used. Various kinds of needles used. Silks, threads, and cottons.

## (b) BOTTOMS :—

4. Leathers used for bottoming ; how produced. The hide and its divisions ; relative quality and uses of the divisions. Wetting and rolling. Ranging and cutting direct. Preparation of bottom stock.

5. Principles of lasting ; methods of drafting ; effects of strains in different directions. Principles and various methods of attachment, direct and indirect. Horizontal and vertical seams. Heels, their building and attachment.

6. Principles and objects of finishing. Styles of finish ; shaping and smoothing ; description of cutters and irons used. Treatment of the bottoms.

(2.) **Practical Examination.**—The Examination will consist of simple practical tests founded on the subjects of the above Syllabus and will be divided into two Sections (a) Uppers and (b) Bottoms. Candidates may pass by qualifying in one division of either Section.

The Written Examination in Grade II will be held on Tuesday, April 30th, from 7 to 10 p.m. The fee for the whole Examination, Written and Practical, is *Two Shillings and Sixpence*.

## GRADE III.

Candidates, as a rule, will be required to have passed in Grade II before being admitted to the Examination in Grade III. For the present, however, on the recommendation of their teachers and with the approval of the Institute, Candidates of not less than 21 years of age may enter for Grade III without having passed in Grade II.

(1.) **Written Examination.**—The Written Examination will consist of a General Section and of Branch subjects. Candidates will be required to satisfy the Examiners in the General Section, and in one at least of the Branch subjects, and will be expected to have a general knowledge of the principles of other branches of the trade.

#### GENERAL SECTION.

A knowledge of the following subjects applied to Boot and Shoe Manufacture :—

1. The application of Geometry to problems dealing with proportion ; the various methods of measuring areas applied to skins and patterns. Use of squared paper.

2. Principles of the lever, pulley, wheel and axle, wedge. Methods of transmitting power, and obtaining variation in speed and motion. Reciprocating, oscillating, and rotary motions. Friction and lubrication.

3. The structure of animal skin ; characteristics and properties of the different fibres. Outline of the various methods of converting skin into leather ; general characteristics of the leathers produced from different skins. Effect of water, chemicals, heat, strain, friction and abrasion upon the various leathers. Adulterants and their detection.

4. The bones of the foot, their shape and position. Structure of bone and cartilage. Difference between bones of infant and adult : ligaments. The muscles ; their position, and the movements caused by them. Skin and connective tissue. Effects of friction and pressure.

#### BRANCH SUBJECTS.

1. **LASTMAKING.**—The woods used ; structure and shrinkage. The various forms and kinds of lasts. Methods of making.

2. **LAST FITTING.**—Description of tape, size stick, and other apparatus. English and foreign units of measurement. Differences between the form of the foot and last. Measuring feet and lasts ; locating the points of measurement. Use of drafts, impressions and casts. How shape and measures should be recorded.

The principles of last fitting. The various fittings and their effect in measurement and shape. Methods of fitting. Defects in lasts and how remedied.

3. **PATTERN CUTTING.**—Principles of *forme* cutting ; various methods employed. Construction of standard upper patterns ; principles underlying the various methods. Cutting the sectional parts. The cutting of insole patterns from the last ; allowances for outsoles according to the method of attachment. Principles of geometrical grading, and their application to the production of sets of patterns for uppers.

4. CLICKING.—The various leathers produced from skins and hides by different treatments, and their characteristics. Various qualities of different parts of skins and hides. Requirements of various parts of uppers with regard to substance, quality and stretch. Systematic and other arrangements of patterns. The principles of clicking systems and their application to skins, hides and fabrics.

5. CLOSING.—Preparation of parts for closing. Seams and edges used. The principles of fitting the parts together by various methods. The sewing machine; a general description of its construction and action. Needles and threads used and stitches produced.

6. SOLE LEATHER CUTTING.—Differences in leather produced by different treatments during manufacture. Character of leather required for various parts of bottoms according to different methods of attachment. Tempering sole leather. Methods of cutting; ranging and cutting direct. Preparation of bottom stock.

7. LASTING.—Principles of lasting, as applied to Blake sewn, welted and turned shoes. The strains used; their effect according to direction and proportion; differences necessary to conform to requirements of various materials, the style of upper, and shape of last. Lasting and accessory machines. The various methods of attachment. Channel closing and bottom levelling. Heel building and attaching.

8. FINISHING.—Principles and objects of finishing. Order of processes; machines and methods used. Paints, stains, and gum finishes. The various styles of finish and their effect upon the appearance of the boot.

9. MACHINE OPERATING.—The simple mechanism of the machines. How the stitch is formed. Necessary adjustment for various work. Needles and threads. Condition of work for successful operating. Speeds. Channelling machines.

(2.) Practical Examination.—Practical Tests may be taken in any one of the following branches:—1. Lastmaking. 2. Last Fitting. 3. Pattern Cutting. 4. Clicking. 5. Closing. 6. Bottom Leather Cutting. 7. Lasting (Hand or Machine). 8. Finishing (Hand or Machine). 9. Machine Operating, either on Blake, Welter, or Stitcher.

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The Written Examination in Grade III and the Final Written Examination will be held on Wednesday, May 1st, from 7 to 10 p.m.; the Practical Examinations on dates to be subsequently fixed. The Fee for the entire Examination in either Grade is *Two Shillings and Sixpence*.

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FINAL EXAMINATION.

*Candidates for the Final Examination in any one Section must hold a Certificate in the corresponding Section of Grade III.*

(1) **Written Examination.**—This will consist of a General Section and of Branch subjects.

GENERAL SECTION.

1. The form of the foot as developed from infancy to maturity; average form; alterations caused by movements. Effects of friction and pressure. Types of feet; classification.

2. Outline of processes by which a last is produced. Meaning of spring, pitch, range, twist. Comparison of sectional forms of various lasts. The usual measurements for British markets.

3. General principles of pattern construction. Study of the chief features of the complete pattern and its parts. Pitch, inclination, spring, draft, relation of lining to outside pattern. How patterns are prepared for factory use.

4. The nature and characteristics of upper leathers. Different leathers and their suitability for various purposes. Methods of finishing leathers. Selection of material for different purposes. Methods of measuring skins. Considerations of stretch as affecting the upper in various stages.

5. The various methods of fitting, and their difference in result. How the various parts should fit; their relation to each other. The importance of skiving and the making of seams. The various types of machines in use.

6. Characteristics of the various leathers used for bottom stock, and their suitability for different purposes. Requirements of the various parts of the bottoms, according to method of attachment. Importance of correct preparation of bottom stock.

7. Principles and practice of drafting; modifications for different hand and machine work. Effect of different "pulls" and the influence of their order upon results; their modification for cut of upper and kind of material. Types of lasting machines. Consideration of different methods of attachment and their result in the completed boot. The heel; its varieties, attachment, and relation to the boot.

8. The objects of finishing, adaptability to class and shape of boot and shoe. Treatment of edges and bottoms to produce different effects.



## 9. The principles of boot and shoe designing.

10. The departmental organization and management in a modern factory, including the selection and costing of the various materials used.

## BRANCH SUBJECTS.

1. **LASTMAKING.**—Designing of models, characteristic features of various lasts. Comparison of outline of last with sole shape. Proportions of various parts of lasts to each other. Action and principles of the last lathe. Various methods of preparing lasts. Sectional lasts.

2. **PATTERN CUTTING.**—As in Grade III, together with modifications necessary in the standard and parts to suit various methods of closing and lasting, and differences in material. The design and production of patterns for various kinds of uppers and bottoms. Methods of grading to conform to different lasts and various trade customs.

3. **CLICKING.**—Comparison of skins from various sources; selection of leathers and relative values; damaged and imperfect skins and their treatment and value; systematic methods and other placing of patterns contrasted; true economy; determining and comparing value bought by weight, selection and area; the cutting of high-class leathers; calculating cost by various methods; checking product and averaging waste, etc. Pattern and cutting areas and their relation to various sized skins.

4. **CLOSING.**—The stitch-forming devices on various sewing machines. Variation of the stitch and its effects. Order of processes in closing and a knowledge of the machines used for skiving, folding, stitching, bagging, etc.

Mechanical properties and uses of silk, cotton and linen threads.

5. **SOLE LEATHER CUTTING.**—As in Grade III, with special knowledge of the requirements of economic factory practice. Sorting bottom stock for quality, substance, and method of attachment. Stock fitting.

6. **LASTING.**—Application of principles to different styles and methods of making (hand and machine). Pulling over by hand and machine. Arrangement of teams for hand and machine work. Actions of different lasting machines and their adaptation to various classes of work. Machines used for attaching and related operations. Heeling machinery.

7. **FINISHING.**—A fuller knowledge of previous year's work, with special reference to application of hand principles to machine finishing. Characteristics and composition of various finishes. A

detailed knowledge of machines used, and order of processes. Special consideration of effects of different speeds.

8. MACHINE OPERATING.—The construction of machines; the various motions, their uses and adjustment; the accessory machines; the theory and practice of waxing and gumming.

(2.) Practical Test. — This will consist of a more difficult examination in the same section as was taken in Grade III, and the Candidate will also be required to show a general knowledge of processes in connection with the manufacture of either Uppers or Bottoms.

II. Full Technological Certificate.—For the full Technological Certificate, the Candidate must qualify as stated in Rules 29 and 30, but Certificates showing that he has passed the Examinations of the Board of Education in Geometrical Drawing, as well as in Freehand or Model Drawing, will be accepted in lieu of *one* of the Science Certificates.

III. Works of Reference.—“Manual of Boot and Shoe Manufacture,” by Hill and Yeoman (Burlington Publishing Co., 72-76, Temple Chambers, Bouverie Street, Fleet Street); “The Human Foot in Health and Disease,” by J. Rhys (Burlington Publishing Co.); “Pattern Cutting made Easy,” by Thomas Brophy (Burlington Publishing Co.); “The Human Foot,” by T. Ellis (Churchill); Northampton Technological Handbooks; “Measurement of Human Foot and Last-Fitting,” by W. J. Lewis; “Last Making and Last Measurements,” by A. E. Tebbutt; “Pattern Cutting,” by H. W. Morris (Burlington Publishing Co.); “Sewing Machinery” by J. W. Urquhart, C.E. (Crosby Lockwood); “The Bones, Muscles, and Ligaments of the Foot” (a movable Atlas of the Foot) (Baillière, Tindall & Cox); “Boot Making and Mending” (Cassell & Co.); “The Manufacture of Boots and Shoes,” by F. Y. Golding (Chapman and Hall); “American Methods of Shoe Manufacture,” by E. Swaysland (Burlington Publishing Company); “Boot and Shoe Design and Manufacture,” by E. Swaysland (Burlington Publishing Company); “Technology of Boot and Shoe Manufacture” by “Crepidam” (Burlington Publishing Company); “Upper Closing” by W. Kilworth (Burlington Publishing Company); Articles on Boot Making in “Cassell’s Technical Educator.” “Boot and Shoe Costing,” by L. C. Headly (Gee & Co., 34, Moorgate Street, E.C.). For works on Leather Manufacture, Tanning, &c., refer to list at the end of Subject 18.

## 20.—SILK DYEING.

I. Syllabus.—The Examination will include questions founded on such subjects as the following :—

## GRADE I.

1. *The Silk Fibre*.—Origin. Silkworm rearing. Cocoon reeling. Chemical composition of raw silk. Sericin and Fibroin. The various kinds of silk threads which are sent to be dyed. Organzine, Tram, Net, Spun, Noils. Chemical and physical properties. Microscopical appearance. Methods of distinguishing from other fibres. Behaviour to acids, alkalies, and other reagents. Effects of temperature upon the silk fibre. Conditioning. Affinity for colouring matters. Wild silks, Tussah and Eria silks. Their composition and behaviour as distinguished from those of ordinary silks.

2. *Artificial Silk*.—Constitution, production, properties and methods of dyeing.

3. *Preliminary Operations*.—Silk in the “gum,” “souple” and “soft” states. Stretching. Soupling. Stripping. Discharging or boiling off. Bleaching. Weighting for blacks and for colours.

4. *Water*.—Natural impurities, their effects in the preliminary operations and in dyeing. Methods of detection and estimation. Correction and purification of natural waters.

5. *Acids, Alkalies, Salts, &c.*—The properties and uses of the principal acids, alkalies, salts and bleaching agents used in silk dyeing. Soaps.

6. *Mordants*.—The role of mordants in general. The preparation, properties and modes of application of the principal metallic mordants used in silk dyeing. Catechu, Valonia, Galls, Sumac, Tannic acid, Chestnut extract, Divi-divi and other tanning matters used in silk dyeing. Their origin, general characters, chemical technology and mode of application.

7. *Colouring Matters* :—(1) *Natural colouring matters*.—Indigo, logwood, brazilwood, peachwood, madder, cochineal, cudbear, orchil, fustic, Persian berries, quercitron, weld, turmeric, annatto and other vegetable colouring matters. Their origin, general characters, chemical technology and mode of application in silk dyeing. Properties of the colours when dyed and methods of detecting the same on the fibre. (2) *The artificial colouring matters* :—Acid colours ; basic colours ; salt colours, or substantive cotton colours ; mordant colours (alizarines and chrome colours) ; developed colours (ingrain colours and developed blacks) ; colours formed on the fibre (insoluble azo colours and aniline black) ; vat colours (indigo and sulphide colours).

8. *Processes after Dyeing*.—Modes of imparting feel, such as “soft,” “hard,” “scoop.” Stringing. Lustreing. Gassing, &c.

9. *Machinery*.—The machinery used in the preliminary and dyeing operations.

10. *Experimental Dyeing*.—The methods of making dyeing experiments.

11. The special treatment required in the dyeing of yarn and cloth, and also of mixed fabrics of silk and cotton and silk and wool.

12. The fastness of colours to washing, light, acids, alkalies, milling, stoving, perspiration, &c.

The examination in both Grades will be held on Wednesday, May 1st, from 7 to 10 p.m. The fee for examination in either Grade is *One Shilling*.

#### FINAL EXAMINATION.

In the Final Examination more difficult questions will be set in the above subjects and Candidates will be expected to have a more detailed knowledge of the same. In addition a knowledge will be required of the following :—

1. The classification of the artificial colouring matters used in dyeing according to their chemical constitution and modes of application.

2. Absorption spectra.—Theory of colour. Use of the spectro-scope in determining the optical properties of colouring matters. Colorimeters.

3. Detection of colouring matters in dyed fabrics. The qualitative examination and commercial analysis of mordants, fixing agents, acids, alkalies, salts, bleaching agents, colouring matters, &c. Colorimetry and capillary analysis.

4. The methods of purification of waste liquors and the utilisation of waste products.

5. Dyehouse management.—The construction and planning of dyeworks. Methods of lighting, ventilating, &c. Calculation of costs, &c.

6. Recent researches in colouring matters and their application. New machinery. Articles of interest to the dyeing industry in the current technical Journals.

II. *Full Technological Certificate*.—For the Full Technological Certificate, the candidate must qualify as stated in Rules 29 and 30, or must obtain Board of Education Certificates in Stage II of Inorganic Chemistry (Theoretical and Practical) and in Stage I of Organic Chemistry (Theoretical and Practical).

**III. Works of Reference.**—"Cellulose," by Cross and Bevan (Longmans); "Researches on Cellulose," by Cross and Bevan (Longmans); "Textile Fibres of Commerce," by Hannan (Griffin); "Chemical Technology of the Textile Fibres," by Georgievics (Scott, Greenwood and Co.); "The Structure of the Cotton Fibre," by Bowman; "The Structure of the Wool Fibre," by Bowman; "The Chemistry and Physics of Dyeing," by Dreaper (Churchill); "Chemistry of the Coal Tar Colours," Benedikt and Knecht (Bell); "Chemistry of the Organic Dyestuffs," by Nietzki, Collin and Richardson (Gurney and Jackson); "Systematic Survey of the Organic Colouring Matters," by Schultz, Julius and Green (Macmillan); "The Synthetic Dyestuffs," by Cain and Thorpe (Griffin); "Chemistry of Dyestuffs," by Georgievics (Scott, Greenwood and Co.); "A Dictionary of Dyes, Mordants, &c.," by Rawson, Gardner and Laycock (Griffin); "Dictionary of the Coal Tar Colours," by Hurst (Heywood and Co.); "Dyers' Materials," by Heerman (Scott, Greenwood and Co.); "Dictionary of Applied Chemistry," by Thorpe; "Commercial Organic Analysis," by Allen; "Trade's Waste," by Naylor (Griffin); "A Manual of Dyeing," by Knecht, Rawson and Loewenthal (Griffin); "The Dyeing of Textile Fabrics," by Hummel (Cassells); "Principles of Dyeing," by Fraps (Macmillan); "Dyeing of Cotton Fabrics," by Beech (Scott, Greenwood and Co.); "Dyeing of Woollen Fabrics," by Beech (Scott, Greenwood and Co.); "Wool Dyeing," by Gardner (John Heywood); "Silk Dyeing and Printing," by Hurst (Bell); "Dyeing," by Sansone (Spon); "Recent Progress in Dyeing," by Sansone (Spon); "Khaki on Cotton," by Theis (Heywood and Co.); "Mercerisation," by Editors of "Dyer and Calico Printer" (Heywood and Co.); "Garment Dyeing and Cleaning," by Hurst; "Colour Printing on Carpet Yarns"; "Science of Colour Mixing," by Paterson (Scott, Greenwood & Co.); "Colour Matching on Textiles," by Paterson (Scott, Greenwood & Co.); "Colour, a Hand book on the Theory of Colour," by Hurst (Scott, Greenwood & Co.).

**Journals.**—"The Journal of the Society of Dyers and Colourists"; "The Journal of the Society of Chemical Industry"; "The Journal of the Chemical Society"; "The Dyer and Calico Printer"; "The Textile Manufacturer"; "The Textile Recorder"; "The Textile Mercury"; "The Illustrated Patent Journal"; "Revue Générale des Matières Colorantes"; "Bulletin de la Société Industrielle de Mulhouse"; "Berichte der Deutschen Chemischen Gesellschaft"; Lehne's "Färber Zeitung"; "Oesterreichs Wollen und Leinen Industrie"; "Zeitschrift für Textil-Industrie."

In addition to the above the manuals, pattern cards and instructions issued by the various aniline colour works should be consulted.

## 21.—WOOL-DYEING.

I. Syllabus.—The Examination will include questions founded on such subjects as the following :—

## GRADE I.

1. *The Wool Fibre*.—Origin ; chief varieties ; general characters ; natural impurities ; microscopical appearance ; physical properties ; chemical composition ; behaviour to acids, alkalies and other reagents ; action of oxidizing agents ; the effect of temperature upon the fibre ; conditioning ; methods of distinguishing from the vegetable fibres.

2. *Water*.—Natural impurities, their effects in scouring and dyeing ; methods of detection and estimation ; correction and purification of natural waters.

3. *Alkalies, Acids, Salts, &c.*—The properties and uses of the principal alkalies, acids, salts and bleaching agents used in wool-scouring and dyeing.

4. *Preliminary Operations*.—The scouring of loose wool, yarn and cloth ; recovery of the waste products from wool-washing and scouring ; yarn stretching ; crabbing ; bleaching.

5. *Mordants*.—The rôle of mordants in general ; the preparation, properties and modes of application of the principal metallic mordants ; assistants ; fixing agents.

6. *Colouring Matters*.—(1) *Natural Colouring Matters*.—Indigo, logwood, the red woods, cochineal and lac dye, cudbear, orchil, fustic, cutch, Persian berries, quercitron. Their origin, general characters, chemical technology and mode of application in wool dyeing. Properties of the colours when dyed and methods of detecting same on the fibre. (2) *Artificial Colouring Matters*.—Acid colours ; basic colours ; salt colours, or substantive cotton colours ; mordant colours (alizarines and chrome colours) ; developed colours (ingrain colours and developed blacks) ; colours formed on the fibre (insoluble azo colours and aniline black) ; vat colours (indigo and sulphide colours).

7. *Theories of Dyeing*.—The mechanical, chemical and other theories of dyeing.

8. *Machinery*.—The machinery used in the preliminary, dyeing and finishing operations.

9. *Experimental Dyeing*.—Methods of making dyeing experiments.

10. The special treatment required in the dyeing and finishing of loose wool, yarn and cloth.

11. The fastness of colours to washing, light, scouring, milling, stoving, acids, perspiration, &c.

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The Examination in both Grades will be held on Wednesday, May 1st, from 7 to 10 p.m. The fee for the Examination in either Grade is *One Shilling*.

#### FINAL EXAMINATION.

In the Final Examination more difficult questions will be set in the above subjects and candidates will be expected to have a more detailed knowledge of the same. In addition, a knowledge will be required of the following :—

1. The classification of the artificial colouring matters used in dyeing according to their chemical constitution and modes of application.

2. Absorption spectra ; theory of colour ; use of the spectroscope in determining the optical properties of colouring matters ; colorimeters.

3. The special treatment required in the preparation, dyeing and finishing of mixed fabrics of wool and cotton and wool and silk.

4. Detection of colouring matters in dyed fabrics ; the qualitative examination and commercial analysis of mordants, fixing agents, acids, alkalies, salts, bleaching agents, colouring matters, &c. ; colorimetry and capillary analysis.

5. The methods of purification of waste liquors and the utilisation of waste products.

6. Dyehouse management ; the construction and planning of dye-works ; methods of lighting, ventilating, &c. ; calculation of costs, &c.

7. Recent researches in colouring matters and their application ; new machinery ; articles of interest to the dyeing industry in the current technical journals.

II. Full Technological Certificate.—See under Silk Dyeing, Subject 20.

III. Works of Reference.—See under Silk Dyeing, Subject 20.

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## 22.—THE DYEING OF COTTON AND OTHER VEGETABLE FIBRES.

I. Syllabus.—The Examination will include questions founded on such subjects as the following :—

### GRADE I.

1. *The Vegetable Fibres*.—Cotton, its origin, chief varieties, and general characters ; microscopical appearance ; physical properties ; methods of distinguishing from other fibres ; the chemistry of cellulose, hydrocellulose, and oxycellulose ; its behaviour to acids, alkalies, and various other reagents ; the effect of temperature upon the fibre ; affinity for colouring matters ; the mercerising process and its practical application.

#### Artificial silks.

Linen, China grass, jute, origin and treatment ; natural impurities ; microscopical appearance.

2. *Water*.—Natural impurities, their effects in bleaching and dyeing ; methods of detection and estimation ; correction and purification of natural waters.

3. *Preliminary Operations*.—Natural impurities in cotton ; foreign substances employed in the sizing, &c., of yarns previous to weaving ; boiling ; bleaching ; methods and machinery employed.

4. *Alkalies, Acids, Salts, &c.*—The properties and uses of the principal alkalies, acids, salts, and bleaching agents used in cotton dyeing ; oxidising and reducing agents.

5. *Mordants*.—The rôle of mordants in general ; the preparation, properties, and modes of application of the principal metallic mordants ; double mordants ; tannic acid and the tannin matters, their origin, general characters, chemical technology, and mode of application ; oil mordants ; assistants ; fixing agents.

6. *Colouring Matters*.—(1.) Mineral colours :—Iron buff, manganese bronze, chrome yellow and orange, khaki, Prussian blue ; methods of dyeing and the properties of the colours when dyed. (2.) Natural colouring matters :—Indigo, cutch, logwood, the red woods, fustic, &c. ; their origin, general characters, chemical technology, and mode of application in cotton dyeing ; properties of the colours when dyed and methods of detecting same on the fibre. (3.) Artificial colouring matters :—Acid colours ; basic colours ; salt colours, or substantive cotton colours ; mordant colours (alizarines and chrome colours) ; developed colours (ingrain colours and developed blacks) ; colours formed on the fibre (insoluble azo colours and aniline black) ; vat colours (indigo and sulphide colours).



7. *Theories of Dyeing*.—The mechanical, chemical, and other theories of dyeing.

8. *Machinery*.—The machinery used in the dyeing of raw cotton cops, hanks, warps, chains, and piece goods.

9. *Experimental Dyeing*.—Methods of making dyeing experiments.

10. The special treatment required in the dyeing of cotton yarns to stand cross dyeing, and also when required to be woven with mixed goods of cotton and wool and cotton and silk.

11. The fastness of colours to washing, acids, perspiration, mangling, hot-pressing, milling, stoving, light, &c.

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The Examination in both Grades will be held on **Monday, April 29th, 7 to 10 p.m.** The fee for the Examination, in either Grade, is *One Shilling*.

#### FINAL EXAMINATION.

In the Final Examination more difficult questions will be set in the above subjects, and Candidates will be expected to have a more detailed knowledge of the same. In addition, a knowledge will be required of the following :—

1. The classification of the artificial colouring matters used in dyeing according to their chemical constitution and modes of application.

2. Absorption spectra ; theory of colour ; use of the spectroscope in determining the optical properties of colouring matters ; colorimeters.

3. Detection of colouring matters in dyed fabrics ; the qualitative examination and commercial analysis of mordants, fixing agents, acids, alkalies, salts, bleaching agents, colouring matters, &c. ; colorimetry and capillary analysis.

4. The methods of purification of waste liquors and the utilisation of waste products.

5. Dyehouse management ; the construction and planning of dyeworks ; methods of lighting, ventilating, &c. ; calculation of costs, &c.

6. Recent researches in colouring matters and their application ; new machinery ; articles of interest to the dyeing industry in the current Technical Journals.

II. Full Technological Certificate.—See under Silk Dyeing, Subject 20.

III. Works of Reference.—See under Silk Dyeing, Subject 20.

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## 23.—COTTON AND LINEN BLEACHING AND FINISHING.

I. Syllabus.—The Examination will include questions founded on such subjects as the following :—

1. *Vegetable Fibres*.—Cotton, linen, ramie, jute, &c. Origin and mode of separating the fibres from the plants. Retting. Physical and chemical structure and properties. Action of chemical agents upon the fibres. Detection of the various fibres. Substances naturally present in the fibres, and such as are introduced during spinning and weaving.

2. *Theory of Bleaching*.—Mode of using and action of the various agents employed in bleaching, *e.g.*, acids, alkalies, lime, hypochlorites, rosin, soap, antichlores, &c. Theory of blueing.

3. *Chemicals* used in bleaching and finishing. Method of ascertaining their commercial value, detecting impurities, &c.

4. *Machinery*, construction and use of : singeing and shearing machines ; high and low pressure boiling pots or "kiers" ; Mather's steamer kier ; liming, souring, chemicking, and washing machines ; rubbing boards ; squeezers ; hydro-extractors ; scutchers and openers ; drying machines ; water, starch, and dry mangles ; back-starching machines ; stentering machines ; stretching, breaking, and damping machines ; calenders, beetling machines, &c.

5. *Water*, with special reference to bleaching and finishing. Methods of detecting and determining impurities. Methods of purification by mechanical and chemical means. Purification of waste liquors.

6. *Practical Operations*.—Full details of the processes employed in the bleaching and finishing of :—

- (a.) Cotton yarns, threads, and cops.
- (b.) Calico (market bleach, Turkey-red bleach, madder bleach).
- (c.) Muslins, lace curtains, &c.
- (d.) Linen yarns, threads, and cloths.

7. New processes and machinery proposed for use or adopted in bleaching and finishing.

In the Examination in Grade I only simple questions will be asked on finishing. Candidates for the Final Examination will be

expected to show a more detailed knowledge of the chemistry of bleaching and finishing agents, and a more intimate acquaintance with the processes, machinery, and plant used.

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The Examination in both Grades will be held on **Wednesday, May 1st, 7 to 10 p.m.** The fee for the Examination, in either grade, is *One Shilling*.

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**II. Full Technological Certificate.**—For the Full Technological Certificate, the candidate must qualify as stated in Rules 29 and 30.

**III. Works of Reference.**—Hummel, "Dyeing of Textile Fabrics" (Cassell, 1886); Lauber, "Handbuch des Zeugdrucks" (Weigel, Leipzig, 1883-9); Lauber, "Neuerungen im Zeugdruck der letzten Jahre"; Stein, "Bleicherei, Druckerei, Färberei und Appretur" (Vieweg und Sohn, Brunswick, 1884); O. N. Witt, "Chemische Technologie der Gespinnstfasern" (Vieweg und Sohn, 1889); Dépierre "Finishing of Cotton Goods" (Thomas, Manchester, 1889); F. H. Bowman, "Structure of the Cotton-Fibre," 1908; H. Monie, Junr., "The Cotton Fibre; its Structure, &c."; E. and F. N. Spon, "Encyclopædia of Industrial Arts and Manufactures," 1880; "Cotton," C. P. Brooks (Spon), 1898; "Recent Progress in the Industries of Dyeing and Calico Printing," Sansone (Griffin); "The Printing of Textile Fabrics," Seymour Rothwell; "Bleaching and Calico Printing," George Duerr (Griffin); Tailfer, "Practical Treatise on the Bleaching of Linen and Cotton Yarn and Fabrics" (translated by McIntosh; Scott, Greenwood & Co.); S. Whitehead, "Modern Bleaching and Finishing" (Heywood, Manchester); P. Bean and W. McLeary, "The Chemistry and Practice of Finishing" (Kirkham and Pratt, Manchester); Cross, Bevan and Beadle, "Cellulose" (Longmans, Green & Co.); Cross and Bevan, "Researches on Cellulose," 1895-1900, and 1900-1905 (Longmans, Green and Co.); Bernard Kozlik, "Technologie der Gewerbeappretur" (Julius Springer, Berlin); "Cotton Finishing" (by the Editor of "The Dyer"); F. Dannerth, "Methods of Textile Chemistry. *Journals*—"Textile Colourist" (Philadelphia); "Textile Manufacturer" (Emmot, Manchester); "Textile Recorder" (Heywood, Manchester); "Textile Mercury" (Manchester); "Dyer, and Calico Printer" (Heywood and Co.); "Journal of the Society of Dyers and Colourists"; "Journal of the Society of Chemical Industry"; "Bulletin de la Société Industrielle de Mulhouse"; "Moniteur Scientifique"; Lehne's "Färber-Zeitung"; "Die Farben-Industrie" (ed. by Börnstein); "Revue générale des Matières colorantes et des Industries qui s'y rattachent"; (L. Lefèvre); "Zeitschrift für Textil-Industrie"; "Revue Mensuelle du Blanchissage, du Blanchiment, et des Apprêts" (Lefèvre and Tailfer).

## 24.—CALICO AND LINEN PRINTING.

I. Syllabus.—The Examination will include questions founded on such subjects as the following :—

## GRADE I.

1. *Vegetable Fibres*.—Cotton, linen, ramie, jute, &c. Their origin; characterisation; chemical and physical properties; preparation for spinning and weaving. Nature of the substances naturally associated with them, and of those introduced in the manufacturing operations.

2. *Water*, with special reference to its use in bleaching, dyeing and printing. Methods of detecting, determining and removing impurities.

3. *Bleaching* for printing purposes. Theory of the process.

4. *Mordants and Mordanting Compounds*.—Metallic salts; gallotannic acid; albumen; oil compounds, &c. Their preparation, modes of application, valuation, &c.

5. *Dyestuffs, &c.*—Various systems of classification :—Natural and artificial; mordant and direct; acid and basic, &c. Natural dyestuffs still employed in calico printing: Logwood, Persian berries, quercitron bark, peachwood, indigo, &c. Chief groups of artificial dyestuffs: Triphenylmethane (magenta, methyl violet, brilliant green, &c.); quinoneoxime; nitro; azo; azine and azonium; oxazine; thiazine; anthracene (alizarines, &c.); sulphide; indigo, &c. Pigments; metals used in printing (aluminium and bronze powders); colour-lakes. Aniline and diphenyl blacks, &c. Mineral colours produced on the fibre: chrome yellow; chrome orange; iron buff; manganese bronze; Prussian blue. Methods of applying and fixing dyestuffs, &c.

6. *Thickening Agents*.—Flour, starches, natural and artificial gums, preparations from sea-weed, &c.

7. *Fixing Agents*.—Silicate, phosphate, arsenate of soda, &c. Antimony salts. Albumen, casein, gelatin, &c. Formaldehyde.

8. *Colour Mixing*.—Preparation of printing-mixtures. Apparatus for grinding, boiling, cooling, mixing, straining, &c.

9. *Printing Styles*.—Dyed styles. Steam or extract styles. Production of colouring matters on the fibre :—Aniline black; insoluble azo-colours, &c. Resist and discharge styles.

10. Practical operations in bleaching, dyeing, printing, finishing, &c.

11. Methods of determining the fastness of colours. Action of acids, alkalis, oxidising and reducing agents, soap solutions, light, &c., upon dyed and printed colours.

12. Methods of making experiments in colour-mixing, dyeing, printing, &c.

13. Mechanism employed in printing. Hand or block printing appliances. Perrotine. Cylinder machine. Machinery of the bleach-house:—Singeing plates, cylinders, &c.; kiers, washing &c. machines; squeezers, &c. Colour-mixing:—pans; agitators, strainers. Ageing and steaming machines. Machinery of the dyehouse:—Dunging, dyeing, washing, soaping and clearing machines, &c. Machinery of the finishing department:—dampening, starching &c. machines, calenders, stentering machines, &c.

### FINAL EXAMINATION.

In the Final Examination more difficult questions will be set in the above subjects and, in addition, a knowledge will be required of:—

1. The more advanced chemistry of the dyestuffs.
2. Resist and discharge styles in general.
3. Combined styles of all kinds.
4. Printing of yarns and warps.
5. Spectroscopic study of colouring matters both in solution and on the fibre. Detection of colouring matters on the fibre.
6. Designs; juxtaposition of colours; complementary colours.
7. A general knowledge of engraving. Sketch-making. Use of photography. Etching. Pentagraph and eccentric engraving. Milling. Hand engraving. Influence of style of engraving on strength and consistency of printing-colour. Selection of method of engraving for different designs.
8. Prevention of nuisance from waste waters and spent wares; utilisation of refuse.
9. Office work. Calculation of costs.

Candidates for the Final Examination will be expected to show a more detailed knowledge of the chemistry connected with Printing and a more intimate acquaintance with the machinery and plant used. *They will also be expected to be acquainted with the more modern work bearing on the subjects of examination, such as is described in the current technical journals.*

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The Examination in both Grades will be held on Tuesday, April 30th, 7 to 10 p.m. The fee for the Examination, in either Grade, is *One Shilling*.

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**II. Full Technological Certificate.**—For the Full Technological Certificate, the candidate must qualify as stated in Rules 29 and 30.

III. Works of Reference. — Knecht, Rawson and Loewenthal, "Manual of Dyeing" (Griffin); C. O'Neill, "Calico Printing, Bleaching, and dyeing," 1878; Gardner, "Bleaching, Dyeing, and Calico Printing" (Churchill, 1884); Sansone, "Printing of Cotton Fabrics" (Heywood, Manchester, 1887); Hummell, "Dyeing of Textile Fabrics" (Cassell, 1908); Benedikt and Knecht, "Chemistry of Coal Tar Colours" (Bell and Sons, 1886); Lauber, "Handbuch des Zeugdrucks" (Weigel, Leipzig, 1883-9); Stein, "Bleicherie, Druckerei, Färberei und Appretur" (Vieweg und Sohn, Brunswick, 1884); Kertész, "Die Anilinfarbstoffe" (Vieweg und Sohn, 1888); Wolff, "Die Beizen" (Vienna, 1885); O. N. Witt, "Chemische Technologie der Gespinnstfasern" (Vieweg und Sohn, 1889); Dépière, "Traité de la Teinture et de l'Impression des Matières Colorantes Artificielles" (5 vols.); C. F. Cross, E. J. Bevan and C. Beadle, "Cellulose" (Longmans, Green and Co.); C. F. Cross and E. J. Bevan, "Researches on Cellulose, 1895-1900 and 1900-1905" (Longmans, Green and Co.); C. Gros-Renaud, "Les Mordants en Teinture et en Impression"; Wladimir Triapkin, "Rongage du Rouge Turc par la Méthode Alcaline"; E. Noelting and A. Lehne "Anilinschwarz und seine Anwendung in Färberei und Zeugdruck"; E. Berthoud, "Traité de la Gravure sur Rouleaux"; F. H. Bowman, "Structure of the Cotton-Fibre," 1908; "Cotton," C. P. Brooks (Spon), 1898; "Recent Progress in the Industries of Dyeing and Calico Printing," Sansone; "The Printing of Textile Fabrics," Seymour Rothwell (Griffin); "Bleaching and Calico Printing," George Duerr (Griffin); and the current technical journals (for list see Cotton and Linen Bleaching and Finishing, Subject 23).

## THE TEXTILE INDUSTRIES.

### EXHIBITIONS AND SCHOLARSHIPS IN THE SEVERAL BRANCHES OF TEXTILE MANUFACTURE OFFERED BY THE WORSHIPFUL COMPANY OF DRAPERS.

With the view to encouraging young men engaged in the Textile Industries of the country to take advantage of the facilities now offered for Technical Instruction in Evening Classes, and to enabling specially promising young men engaged in these industries to qualify themselves by courses of advanced study in Technical Day Colleges for the higher posts in mills and manufactories, the Drapers' Company have resolved to establish and to award on the results of the Technological Examinations of the City and Guilds of London Institute to be held in the year 1912, the exhibitions and scholarships hereinafter mentioned.

The EXHIBITIONS will be termed the Drapers' Company's Textile Industries Exhibitions. They will be of the value of £10 per annum

each, and will be tenable for two years, and may be renewed in exceptional cases for a third year. They will be awarded on the result of the Institute's Examination in Grade I in the SPINNING and WEAVING Branches of the following five Textile subjects, viz. :—COTTON, WOOLLEN or WORSTED, LINEN, SILK and JUTE. The Exhibitions will be tenable under a condition that the holder pursues an approved course of evening instruction in Textiles and cognate subjects, and the renewal of the Exhibition for a second year will, as a rule, be dependent on his passing satisfactorily the Institute's Examination in Grade II at the end of his first session.

The SCHOLARSHIPS will be termed the Drapers' Company's Textile Industries Scholarships. They will be of the value of £60 per annum each, and the Company will pay in addition the holders' School or College tuition fees, to an amount not exceeding £25 per annum for any one scholar. The Scholarships will be tenable for two years, and will be renewed in deserving cases for a third year. The holders must attend an approved day course of study at a Technical School or College, or other place of higher education approved by the Company. The Scholarships will be awarded on the result of the Institute's Examination in Grade II of WOOLLEN and WORSTED WEAVING, COTTON WEAVING, LINEN WEAVING, and JUTE WEAVING, and on the result of the Examination in Grade I of SILK WEAVING.

The Exhibitions and Scholarships will not be tenable with other Exhibitions or Scholarships without the consent of the Company, and they will be subject to forfeiture, should the holders fail to attend regularly to their studies and to make due progress therein, and to maintain a good moral character. Evidence on these points will have to be given from time to time to the Company whose decision in every case will be final.

An Exhibition or Scholarship will not be awarded unless there is a candidate duly qualified in the opinion of the Company for it, and in making the award the Company reserve the right to consider not only the Examination marks gained, but any other circumstance which they think may bear upon the case and should affect their decision. Candidates for Scholarships may be required to give some account of their previous school training.

Textile Scholarships will be awarded to those Candidates only whose parents are not in a position to enable them to attend the full Day courses of study at a place of Higher Technical Education without the assistance provided by the Scholarships. This regulation is not intended in any way to restrict the entry of Candidates for examination. Successful Candidates who do not come under the category of those eligible for Scholarships may retain the title of Scholar, but will be expected to waive all claims to money payments and allowances in favour of those less fortunately situated.

The number of Exhibitions offered for competition at the 1912 Examinations will be twenty, two in each branch of the five Textile Industries mentioned. The number of Scholarships offered for competition will be five, one in the Weaving branch of each of these Industries.

Candidates for Exhibitions must be between 16 and 20 years of age on the 31st day of March, 1912, and must have worked for at least one year previous to that date at some one branch of Textile Industry. Candidates for Scholarships must be between 18 and 23 years of age on that date and must have worked for at least two years at some one branch of Textile Industry. Every Candidate will be required to produce a certificate from his employer as to the particular branch of the industry in which he is engaged, and to the effect that he has worked for the prescribed period and that his attendance at work and conduct have been satisfactory.

For further information with respect to these Exhibitions and Scholarships apply to the Clerk to the Drapers' Company, Drapers' Hall, Throgmorton Street, London, E.C., or to the Superintendent, Department of Technology, City and Guilds of London Institute, London, S.W., from whom forms of application may also be obtained, which must be returned to the Clerk of the Drapers' Company duly filled in not later than **March 11th, 1912.**

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## 25.—WOOLLEN AND WORSTED SPINNING.

The course of instruction is intended to cover three years. Each year's work is indicated in the following syllabuses, which form a continuous and progressive course of study.

Before entering upon the First Year's course of instruction in the Technology of the subject, all students are recommended to attend a Preliminary course of lessons, covering a period of two years, in English, Arithmetic, Drawing and General Elementary Science, and the qualifications of each student as regards these preliminary subjects must be submitted to the Institute at the commencement of the session. No candidate under 20 years of age will be admitted to the Examination in Grade I, who is unable to produce evidence of having acquired the necessary knowledge of these subjects, prior to his admission to the First Year's course of technological instruction.

The holding of the Preliminary Technical Certificate, issued by the Union of Lancashire and Cheshire Institutes or by the Midland Counties Union or by the West Riding County Council, provided that the optional subject taken in each case is Experimental Mechanics and Physics, or the Preliminary Technical Certificate of the National Union of Teachers, or the passing, prior to the commencement of the students' Technological Course, of an



examination held under the direction of the Local Education Authority or the School Authority on a syllabus which has been approved by the Institute, will be accepted as evidence. Other evidence for consideration must be submitted at the commencement of the Session.

Candidates from Centres in Scotland will be admitted to the examinations provided they satisfy the Scotch Education Department that they have received the necessary preliminary training.

Candidates, by permission of their Teachers, may enter in the same year for the Examinations both in Grade I and Grade II.

The Examination in Grade II and the Final Examination will consist of three divisions. Division I will have reference to general questions; Division II to worsted spinning only, and Division III to woollen spinning only.

Candidates may be required to state from actual inspection the properties of samples of wool to be submitted to them and the purposes for which they are specially adapted. Samples of yarn or materials from the different processes may also be supplied, and candidates may be required to state the kind of materials used in their production and to give a detailed description of the methods of manufacture.

I. Syllabus.—The Examinations will include questions founded on the following subjects:—

#### GRADE I.

1. *Raw Materials*.—Wool, mohair, alpaca, cotton, and silk. The differences in clothing properties, physical structure, chemical composition, and microscopic appearance of these fibres.

2. *Wool Substitutes*.—Noils, flecks, mungo, shoddy, and extract. Methods of production and the uses to which these materials are applied in the woollen industry.

3. *Rag-Grinding Machinery*.—Its principle of construction, and how altered for producing shoddy and mungo respectively. The carbonizing or extracting process for separating wool and worsted yarns from goods in which cotton has been used.

4. *Wool-Growing Countries*.—The clothing and other qualities of the wools of Great Britain, Saxony, Russia, Australia, New Zealand, Tasmania, South Africa, River Plate, &c. The special kinds of yarns and fabrics for which the wools of these countries are used.

5. *Sorting*.—The classification of the different qualities in the fleece for woollen, worsted, mohair, and alpaca yarns. The relative fineness, elasticity, strength and spinning qualities of the different sorts of wool in the fleece.

6. *Scouring*.—Methods of washing wool. Wool-washing machinery. Utilisation of waste scour liquor and processes for recovering the oil or fatty matter, and other bye-products. The nature of the soaps and alkalies used in scouring. Methods of testing the same and their effects on the wool. The properties of hard and soft water, and the methods and principles of water-softening and purification.

7. *Drying*.—Construction and comparisons of various types of drying machinery, and their suitability for various classes of material.

8. *Burring*.—The mechanical and chemical methods of extracting burrs.

9. *Teazing, Blending, and Oiling*.—Construction of the shake-willy and fearnought or teaser, and setting of the same. Blending for different qualities of yarns and blending for fancy mixtures. Methods of oiling. The object of the process. Properties of the oils used and how tested.

10. *Calculations*.—On the machinery used in drying, scouring, burring, and teasing, and also on the relative value of wool in the raw or greasy, and clean state, and on the blending of wools of different values, &c.

The Examination in Grade I will be held on **Monday, April 29th**, from 7 to 10. The fee for the Examination is *One Shilling*.

No Certificates will be given on the results of the Examination in Grade I only, but the candidates' successes will be communicated to the centres where they were examined.

## GRADE II.

*Certificates will be issued to those Candidates only who have passed the Examination in Grade I in the same or a previous year.*

More advanced questions will be set on the subjects of the syllabus for Grade I and also on the following :—

1. Preparation of wools for worsted yarns (*a*) for long staple wools (prepared by gilling), and (*b*) for merino and short staple wools (carded). Details of the construction of the gill box. The entire routine of gilling, or preparing, and the arrangement of boxes employed.

2. Construction of the worsted carder and methods of fixing, setting and altering for various classes of wool.

3. *Backwashing*.—Backwashing machinery. Objects and effects of the process.

4. *Combing*.—Different kinds of combing machines, such as Lister's, Noble's, Holden's, and Heilman's. Setting of the combs

for different qualities of wool and methods of regulating the relative weights of top and noil.

5. *Carding for Woollen Yarns*.—Scribbling and carding for medium and low class yarns, *e.g.*, from 5 to 18 skeins, and also for fine yarns and better qualities, 18 to 30 skeins and upwards. Comparison between the English and Belgian systems of carding. Productive power of scribbling and carding engines. Relative speeds of the cylinders.

6. *Card Clothing*.—Fixing of card clothing and grinding of the same. Relative fineness of the counts and suitability of the cards for the several cylinders of the machines, and also for different materials whether wool, mungo, extract, or a blend of wool and wool substitutes.

7. *Card-Feed Appliances*.—Methods of feeding scribbling and carding engines. Comparative value of manual and mechanical systems. The action of hopper, ball, Scotch, Blamire, and rope feeds.

8. *Garnetting*.—Construction of the Garnett machine and the kinds of material to which it is adapted.

9. *Calculations*.—On the productive capacity of the different machines referred to in this section of the syllabus. Also on wheel gearing and on costing for the preparation of the top in worsted yarn making.

The Examination in Grade II will be held on Tuesday, April 30th, from 7 to 10. The fee for the Examination is *One Shilling and Sixpence*.

### FINAL EXAMINATION.

*Candidates for the Final Examination must hold a Certificate in Grade II.*

In the Final Examination, more advanced questions will be set on the subjects of the previous Grades, and also on the following :—

1. *Condensing for Woollen Yarn*. Construction of all the various types of condensers, and their relative merits. Qualities of the condensed slivers.

2. *The Processes of Drawing Worsted Yarns*.—The principles of drawing. The open, cone, and French drawing processes. The kind of material for which each type of box is most suitable. The mechanism of the different drawing frames.

3. *Mule Spinning*.—Construction and comparisons of the woollen and worsted spinning mules, and reasons for their differences. Details of all the various motions. Methods of changing for different thicknesses of yarns and for spinning yarns of different degrees of twist, &c.

4. *Spinning Machines for Worsted Yarns.*—The ring, cap, and flyer frames. The kinds of yarn for which they are specially adapted and details of the mechanism of each frame.

5. *Twist Yarn and Twisting Frames.*—Various classes of twist or compound threads such as 2-fold up to 6-fold, also the construction of fancy yarns such as curl, knop, loop, flake, cloud, spiral, &c., &c. Details of the construction of the machines required for their production. Amount of twist in warp and weft yarns for various makes of fabrics. Number of turns per inch for different counts of yarns.

6. *Systems of counting yarns.* The uses of cotton and silk threads in the worsted and woollen trades.

7. *The Process of Gassing or Genapping.*—Its effect upon yarns, especially braid and heald yarns.

8. *Reeling and Bundling.*—The construction and operation of the machinery required for these processes, and the usual make-up of hanks and bundles to suit different branches of the trade.

9. *Calculations.*—(a) On the costing of yarn making from the raw material to the spun thread; (b) on twists and compound threads; and (c) on the speeds of machines and their output.

10. The special qualities of the various types of woollen and worsted threads. The different purposes for which they are used, such as for coatings and suitings, dress and mantle fabrics, carpets, hosiery, &c.

11. Defects arising in the manufacture of yarns, their causes and remedies. The special properties of yarns dyed in the wool, top, or hank.

12. Testing of fibres and yarns, and commercial tests for oils and soaps.

The Final Examination will be held on **Tuesday, April 30th**, from 7 to 10. The fee for the Examination is *Two Shillings and Sixpence*.

**II. Full Technological Certificate.**—For the Full Technological Certificate, the candidate must qualify as stated in Rules 29 and 30, but certificates showing that he has passed the Examinations of the Board of Education in Geometrical as well as in Freehand or Model Drawing will be accepted in lieu of one of the Science Certificates.

**III. Works of Reference.**—C. Vickerman, "The Woollen Thread, its Nature, History, Structure, and Use" (Huddersfield), 1880; G. C. Burns, "American Woollen Manufacture; a practical treatise on the Manufacture of Woollens" (Central Falls, R. I.), 1872; "Spinning Woollen and Worsted," by W. S. B. McLaren (Cassell), "Textile Manufacturer" journal (Manchester); "British Manufacturing Industries" (Stanford); "Textile Educator" (Huddersfield), 1888; "Woollen and Worsted Cloth Manufacture," by R. Beaumont,

"Structure of the Wool Fibre by Dr. Bowman" (Palmer and Howe, Manchester); "Textile Recorder" Journal (Manchester); "The Textile Journal" (London and Manchester); "History of Wool and Wool-combing" by J. Burnley (Sampson Low and Co.); "Textile Fibres of Commerce" by Hannan (Griffin, 1902); "Australian Wool Classing" by G. Jeffrey (Adelaide, 1899); "Australian Sheep and Wool" by A. Hawkesworth (Sydney, 1900); "Principles of Wool Combing," by H. Priestman (Geo. Bell and Sons, 1904); "The Graphic Yarn Calculator," by Thos. Oliver, D.Sc. (Craighead, Galashiels, 1905).

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## 26.—WOOLLEN AND WORSTED (AND MIXED FABRICS) WEAVING AND DESIGNING.

The Examination will be divided into two Divisions, each division covering the subjects of three years' courses of study which are intended to be continuous and progressive. Candidates must state prior to examination in which Division they intend to present themselves, and they will be required to take the same division in each grade.

Before entering upon the First Year's course of instruction in the Technology of the subject, all students are recommended to attend a Preliminary course of lessons, covering a period of two years, in English, Arithmetic, Drawing and General Elementary Science, and the qualifications of each student as regards these preliminary subjects must be submitted to the Institute at the commencement of the session. No candidate under 20 years of age will be admitted to the Examination in Grade I, who is unable to produce evidence of having acquired the necessary knowledge of these subjects, prior to his admission to the First Year's course of technological instruction.

The holding of the Preliminary Technical Certificate, issued by the Union of Lancashire and Cheshire Institutes or by the Midland Counties Union or by the West Riding County Council, provided that the optional subject taken in each case is Experimental Mechanics and Physics, or the Preliminary Technical Certificate of the National Union of Teachers, or the passing, prior to the commencement of the students' Technological Course, of an examination held under the direction of the Local Education Authority or the School Authority on a syllabus which has been approved by the Institute, will be accepted as evidence. Other evidence for consideration must be submitted at the commencement of the Session.

Candidates from Centres in Scotland will be admitted to the examinations provided they satisfy the Scotch Education Department that they have received the necessary preliminary training.

The work of each division is defined in the following syllabus.

**DIVISION I.**—The questions in this division will relate to designing, weaving, and finishing of woollen, worsted, and union textures, chiefly of a trousering, coating, and suiting class, as well as to rugs, mauds, vestings, &c.

**DIVISION II.**—The questions will relate to the designing, weaving, and finishing of the various classes of worsted, woollen, and mixed fabrics made for dresses, mantlings, mauds, rugs, tapestries and carpets.

Candidates, by permission of their Teachers, may enter in the same year for the Examinations in both Grade I and Grade II.

No Certificates will be awarded on the results of the Examination in Grade I, but the Candidates' successes will be notified to the centre where they were examined. The Examination in Grade II will consist of two papers, which must be taken in the same year.

The Final Examination, in both Divisions I. and II., is divided into two Sections, Section A, Designing, and Section B, Mill Management. The written examination in each division will comprise three papers, (1) General, (2) Designing, and (3) Mill Management, and Candidates must pass in (1) and (2) or (1) and (3) to obtain a certificate, but Candidates may, in the same year, take the examination in both Sections A and B of either Division I. or Division II. Candidates in either Division are required to submit Specimen Work.

## I. Syllabus :—

### DIVISION I.

#### GRADE I.

1. *Yarns.*—The qualities of woollen, worsted, cotton, mohair, and silk yarns; also yarns made of ramie fibre, camel hair and silk substitutes: the points in which they differ from each other in structure. Systems of counting the following yarns:—Silk, cotton, worsted, Yorkshire skein, West of England and Gala cut. Reducing from one system to another. Calculations on twist yarns. Calculations of warps and wefts.

2. *Preparatory Processes, or Loom Mounting.*—Warping, sizing, and beaming.

3. *Drafting and Healding.*—Various schemes of healding. Drafting of designs on to the lowest number of leaves or heald shafts. Completion of designs from draft and pegging plans. Calculations on healding and slewing.

4. *Hand Looms.*—Construction of the treadle loom. Methods of mounting; tie-up or cording plans. Single and double-action dobbies or witches. Jacquard hand looms.

5. *Tappet Power Loom*.—Various parts of the tappet loom and their functions. Shedding, picking, beating-up, and other motions. Setting and timing of the several parts.

6. *Cloth Structure*.—Fundamental principles of the structure of single cloths. Uses of point paper and the relation of plans or weaves to the build of the cloth. Drawings of sections of fabrics from given weaves.

7. *Designing*.—Single-make textures in solid colours. Common weaves and their settings. Running out weaves and determining when simple designs are complete. Methods of constructing new weaves. Different classes of single-makes, namely:—Plain, hopsacks, regular twills, and the derivatives of these weaves.

8. *Colouring*.—Illustrating on point paper the patterns obtained in plain, hopsack and regular twill makes, by varying the method of warping and wetting, in not more than four colours.

9. *Pattern Analysis*.—The dissection of single cloths in light warps and dark wefts, for weave only, in solid colours.

*Obligatory questions will be set, (1) on pattern analysis, (2) on calculations relating to the counts of twist, folded or compound threads. The counts in such obligatory questions, both in this and in the higher Grades, will be limited to "woollen" (yards per dram), "worsted," "cotton" and "spun silk."*

## GRADE II.

1. *Yarns*.—Advanced questions on Section 1. of the syllabus for Grade I. The twine in single and folded yarns. The effect of twine on weave and finish. Defects caused by yarns.

2. *Yarn Testing*.—Methods of testing woollen, worsted and mixed yarns. Construction and use of the apparatus employed for this purpose.

3. *Calculations*.—Problems on the diameter of threads and setting of cloths. Speeds of looms. Costing of twist yarns and fabrics.

4. *Power Looms*.—The construction and running of power looms for weaving piece-dye fabrics, *e.g.*, coatings and suitings. The construction and timing of various parts and motions of the loom, but not shuttle box motions. Pattern chain making. Chief points in the loom which cause defects in the cloth. Loom calculations. Jacquard power loom, single and double lift, centre and open shedding.

5. *Designing*.—All types of single and backed textures (warp-backed and weft-backed) in solid and fancy colourings suitable for men's wear. Vesting designs in single cloths. Reversible (cotton warp and woollen weft) and single-made mauds and rugs. Combinations of different weaves to form stripes, checks, and other patterns. Whipcords, corkscrews, cord and rib styles, single and

backed. Designs due to combining two or more weaves, thread and thread, and pick and pick, with peculiarities of setting and shrinkage. Defects caused by weave structure.

6. *Colour*.—Attributes of primary, secondary, and tertiary colours and also their derivatives. Principles of applying colour to woven design. Sketching of patterns due to combining coloured threads in single and backed weaves. Analysis of coloured sketches. Harmonies of analogous colours and harmonies of contrasting colours. Effects of juxtaposition of colours. Position of bright colours in designs and their effects upon the general colour tone of the pattern. Relative weight and balance of colour. Contrast in pattern making or the laws governing the blending of colour to preserve the style or design when composed of several patterns.

7. *Pattern Analysis*.—The dissection of backed and single fabrics, also combinations of single-makes in woollen, worsted and union cloths for men's wear, with full particulars of colouring, counts of yarn, threads per inch in the loom and finished fabric, shrinkage of warp and weft, draft and pegging plan, weight and cost per yard.

*Obligatory questions will be set, (1) on pattern analysis, (2) on calculations relating to the diameters of threads and setting of cloths.*

#### FINAL EXAMINATION.

The Examination will be Written and Practical.

(1. *Written Examination*.—Candidates must pass in the General Section and Section A, or the General Section and Section B, in order to obtain a certificate. Both Sections A and B may be taken in the same year.

*Obligatory questions will be set, (1) on pattern analysis, (2) on calculations relating to the costing of fabrics.*

#### GENERAL SECTION.

1. *Yarns*.—The construction of two, three, or more ply twist yarns. Curls, knops, gimps, in worsted, woollen, cotton, silk, and mohair, and their effects in the finished fabric, with calculations on counts and price.

2. *Calculations*.—Every variety of textile calculations on yarns, fabrics, looms, and cost of manufacture.

3. *Compound Cloths*.—Structure of double, treble, and compound cloths. Defects caused by weave structure.

4. *The Power Loom*.—Construction and running of power looms for weaving fancy woollen, worsted and mixed fabrics. Shuttle box mechanism. Warp and weft stop motions.



5. *Pattern Analysis*.—Dissection of all kinds of double and compound fabrics for men's wear, with full particulars for re-making, shrinkage, weight, cost per yard.

### SECTION A.—DESIGNING.

1. *Jacquard Loom*.—Methods of harness mounting, and of tying-up the harness for bordered and other fabrics. Modifications of the Jacquard for increasing its figuring capacity. Card stamping and repeating apparatus. Calculations on casting out.

2. *Designing*.—Reversible and lined cloths, double plain, twill, and other patterns. Principles of figuring double cloths. The effects produced by the application of coloured yarns to backed, double, and compound textures. The figuring of double-make fabrics with wadding or centre warp, weft or both. Cut cloths in which the effect is got by reversing the weave, and also those in which it is due to using special threads and picks.

3. *Colouring*.—Colouring and designing of vestings, mauds, rugs and shawls.

### SECTION B.—MILL MANAGEMENT.

1. Defects arising in the construction of woven fabrics owing to the faulty adjustment and running of machinery; causes and remedies. The testing of yarns and cloths.

2. *Finishing*.—The various processes through which the cloth passes after it leaves the loom, such as knotting, scouring, mending, milling, raising, cropping, boiling, crabbing, brushing, pressing, and steaming. The different classes of finish, as doeskin or dress face, velvet, melton, Scotch, and dry or bare and worsted finish. The effect of scouring and milling upon design and colour. The construction of the several machines used in finishing. A general knowledge of soap, soda ash, ammonia, fuller's earth, urine substitute, and other materials used in scouring and milling, and their effect upon the colours, the fabric, and the fibres of the wool, or other materials.

3. *Machinery*.—The general points of the wear and tear, and defects. Recent developments in machinery. Economic arrangements of machinery. Gearing, driving, with special reference to friction. Output of machinery and its effect on the cost of the fabric.

4. *Departmental Control*.—Organisation of weft, warp, beaming, healding, weaving and other departments.

5. *Mill Book-keeping and Departmental Costing*.—The relation of these subjects to the costing of the fabric.

6. *Mill construction*.—Natural and artificial lighting, heating and ventilation.

*For note as to dissection of patterns see page 124.*

(2.) *Practical Work. See page 122.*

## DIVISION II.

### GRADE I.

1. *Yarns*.—The qualities of woollen, worsted, cotton, mohair, and silk yarns; also yarns made of ramie fibre, camel hair, and silk substitutes; the points in which they differ from each other in structure. Systems of counting the following yarns:—Silk, cotton, worsted, Yorkshire skein, West of England and Gala cut. Reducing from one system to another. Calculations on twist yarns. Calculations of warps and wefts.

2. *Preparatory Processes, or Loom Mounting*.—Warping, sizing, and beaming.

3. *Drafting and Healding*.—Various schemes of healding. Drafting of designs on to the lowest number of leaves or heald shafts. Completion of designs from draft and pegging plans. Calculations on healding and slewing.

4. *Hand Looms*.—Construction of the treadle loom. Methods of mounting; tie-up or cording plans. Single and double-action dobbies or switches. Jacquard hand looms.

5. *Tappet Power Loom*.—Parts of the tappet loom and their functions. Drawing of tappets or wipers to scale. Shedding, picking, beating-up and other motions. Setting and timing of the motions of the loom.

6. *Cloth Structures*.—Fundamental principles of the structure of single cloths. Uses of point paper and the relation of plans or weaves to the build of the cloth. Sketching of sections of fabrics from given weaves.

7. *Designing*.—Single and fancy weaves. Methods of constructing weaves on a sateen base, by re-arrangement of threads and picks, by transposition, and by combining two or more simple weaves, pick and pick, and thread and thread. Derivatives of common twills. Mats, cords, sateens, small diagonals, corkscrews, and other fancy weaves.

8. *Colouring*.—The production of patterns in common weaves by the arrangement of coloured yarns.

9. *Pattern Analysis*.—The dissection of single-made dress fabrics for weave only.

10. Setting of standard makes of dress fabrics, and elementary data relative to the setting of single-weave textures.

*Obligatory questions will be set, (1) on pattern analysis, (2) on calculations relating to the counts of twist, folded or compound threads. The counts in such obligatory questions, both in this and in the higher Grades, will be limited to "woollen" (yards per dram), "worsted," "cotton" and "spun silk."*

## GRADE II.

1. *Yarns*.—Advanced questions on Section 1. of the syllabus for Grade I. The twine in single and folded yarns. The effect of twine on weave and finish. Defects caused by yarn structure.

2. *Yarn Testing*.—Methods of testing woollen, worsted and mixed yarns. Construction and use of the apparatus employed for that purpose.

3. *Calculations*.—Problems on the diameter of threads and setting of cloths. Speeds of looms. Costing of twist yarns and fabrics.

4. *Power Loom*.—The construction and running of power looms for weaving dress fabrics. Construction of the single and double-action and open shed dobbies; revolving and rising box mechanisms. Warp let-off and piece take-up motions. The points of wear and tear in the loom.

5. *Designing*.—Combinations of weaves in stripes, checks, and other forms. The arrangement of spots or figures on sateen and other bases for dress and mantle fabrics. Special kinds of weaves suitable for tweeds, dress stuffs, lustres, worsteds, and mixed textures. Defects caused by weave structure.

6. *Colour*.—Attributes of primary, secondary, and tertiary colours, and also their derivatives. Principles of applying colour to woven design. Sketching of patterns due to combining coloured threads in single weaves. Analysis of coloured sketches. Harmonies of analogous colours and harmonies of contrasting colours. Effects of juxtaposition of colours. Position of bright colours in designs, and their effects upon the general colour tone of the pattern. Relative weight and balance of colour. Contrast in pattern making, or the laws governing the blending of colour to preserve the style or design when composed of several patterns. Compound arrangement of shades as developed in single weaves.

7. *Pattern Analysis*.—Dissection of single-make dress and mantle textures, comprising weave or design, healding draft, pegging plans, patterns of warp and weft, counts of yarn, set, and all weaving particulars.

*Obligatory questions will be set, (1) on pattern analysis, (2) on calculations relating to the diameters of threads and setting of cloths.*

## FINAL EXAMINATION.

The Examination will be Written and Practical.

(1.) **Written Examination.** Candidates must pass in the General Section and Section A, or the General Section and Section B, in order to obtain a certificate. Both Sections A and B may be taken in the same year.

*Obligatory questions will be set, (1) on pattern analysis, (2) on calculations relating to the costing of fabrics.*

### GENERAL SECTION.

1. *Yarns.*—The construction of two, three, or more ply twist yarns. Curls, knops, gimps, in worsted, woollen, cotton, silk and mohair, and their effects in the finished fabric, with calculations on counts and price.

2. *Limitations in textile design* imposed by the material, yarn structure, weave, machinery, colour and finish.

3. *Calculations.*—Every variety of textile calculations on yarns, fabrics, looms, and cost of manufacture.

4. *Compound Cloths.*—Structure of backed double, treble and compound cloths. Defects caused by weave structure.

5. *Pattern Analysis.*—Dissection of compound dress, mantle, and other fabrics, including gauzes and plushes.

6. Defects arising in the production of woven fabrics—causes and remedies.

7. Relative advantages of different systems of shedding. Drop box shuttle motions. Warp and weft stop motions.

8. *Jacquard or Harness Loom.*—Construction of single- and double-action, and open shed machines. Methods of harness mounting. Card stamping and repeating apparatus. Calculations on casting out.

### SECTION A.—DESIGNING.

1. *Various Classes of Figured Cloths for Mantles, Dress Goods, and Costumes.*—Figured fabrics coloured in the warp for mantles, and dresses; also fabrics figured in the weft for vestings, carriage rugs, matelasses, and mantle cloths.

2. *Reversible Fabrics.*—(a) Reversible in the weft, (b) in the warp and (c) in both warp and weft.

3. *Structure of Leno and Gauze Fabrics.*—Principles of designing these textures and methods of mounting the loom for weaving them, whether in tappet, dobbie, or Jacquard loom.

4. *Pile Fabrics.*—Structure of plushes. Warp and weft pile textures comprising velvets, velveteens, figured plushes, carpets.

5. *Colouring.*—Advanced questions on Section 6 of the syllabus for Grade II. Application of colour to extra warp, extra weft, and both extra warp and extra weft fabrics.

6. *The Jacquard Machine.*—Special types of Jacquard loom. Twilling and border machines. Pressure healds and other harness and shaft mountings. Gauze harness. Methods of drafting for complex harness mountings. Calculations on the Jacquard loom.

7. Swivel loom and swivel weaving and designing.

## SECTION B.—MILL MANAGEMENT.

1. *Machinery*.—Recent developments in warping, beaming, and weaving machinery. Adjustment and arrangement for economic running. Methods of gearing, driving.

2. *Automatic Weft Motions*.—Different types of these looms, their construction and efficiency.

3. Modifications of the several motions of the loom for special purposes, such as crammed stripes or checks, large patterns where weave and colour must fit, gauze harness and heald combinations.

4. *Output of Machinery*.—The productive power of preparatory machinery and looms, and the effect on the price of the woven fabric.

5. Selection and planning of preparing and weaving machinery for specified work, such as lustres, serges, tweeds, mantles, plushes, velvets, pile and fancy fabrics.

6. *Finishing*.—Processes of finishing, and the routine through which dress and mantle fabrics pass after they leave the loom. General knowledge of the construction of the several machines used in finishing.

7. *Departmental Control*.—Organisation of weft, warp, beaming, healding, weaving and other departments.

8. *Mill Book-keeping and Departmental Costing*.—The relation of these subjects to the costing of the fabric.

9. *Mill Construction*.—Natural and artificial lighting, heating and ventilation.

## DIVISION I AND DIVISION II.

## (2.) Practical Work.

Candidates taking Division I., Section A, will be required to submit original styles in *two* at least of the following classes of fabrics :—

- (a) Fancy woollens.
- (b) Worsted trouserings.
- (c) Worsted suitings.
- (d) Piece-dye or mixture coatings.  
(Not less than nine designs in this class, but only one colour to each design.)
- (e) Vestings.
- (f) Rugs, mauds, and shawls.
- (g) Overcoatings.

In order to obtain the full number of marks, not less than thirty-six patterns must be submitted, three colourings in each range, and with at least three ranges in each class. Descriptive notes must be given by the Candidate on the ranges of patterns, stating in what respect the design, scheme of warp and weft colouring, and the build of cloth claim to be original or advantageous.

Candidates taking Division I., Section B, will be required to submit original cloths in *two* of the following classes of fabrics :—

- (a) Woollen suitings.
- (b) Worsted trouserings.
- (c) Worsted suitings.
- (d) Piece-dye worsted coatings and suitings.
- (e) Overcoatings.

The woven samples must be 6 ins. by 8 ins., and in four different weights per yard in each class selected. Descriptive notes must be given by the Candidate on the ranges of patterns, stating in what respect the design and build of the cloth claim to be original or advantageous.

Candidates for Division II., Section A, must submit woven specimens, with designs and weaving particulars, in at least *two* of the classes of fabrics named :—

- (a) Dress fabrics.
- (b) Mantles.
- (c) Plushes, figured velvets.
- (d) Rugs.
- (e) Tapestries.
- (f) Carpets.

Such designs must occupy not less than 144 threads, be of a figured character, and woven in three methods of colouring.

Candidates in Division II., Section B, must submit not less than three patterns in *three* of the above classes of fabrics of a non-figured character, preferably dobbie patterns, to show a competent knowledge of fabric structure, weave composition, and colouring.

All work, whether for Division I. or II., should be mounted on cards, on which the weaving particulars should be written. Each Candidate's work *must be accompanied by* a certificate signed by his employer, or by the class teacher and a member of the School Committee, stating that the design has been produced by the Candidate, and the work has been executed by him without assistance. Forms for the Certificate may be had on application.

The specimens must be forwarded to the Institute (*carriage paid*) on or before April 29th.

The following particulars as to the part the Candidate has taken in the origination of the specimens should be stated on each range

or pattern, whether the work is for Division I. or Division II. of the Examination :—

- (1) Design or plan of weaving.
- (2) Scheme of warp and weft colouring.
- (3) Build of the cloth.

In dissecting patterns at the Written Examinations, Divisions I. and II., Candidates may use sample yarns or balances for ascertaining the counts of yarn. The actual weight of the pattern given will be quoted, from which the average counts of yarn may be calculated, but any difference of counts in the several yarns in the fabric must be estimated by the student.

The Examination in Grade I, in both Divisions, will be held on Wednesday, May 1st, from 7 to 10 p.m. The fee for Examination in either Division is *One Shilling*.

The Examination in Grade II, in both Divisions, will be held in two parts, which must be taken in the same year. The First Part, on Sections 1-4 of the Syllabus, will be held on Thursday, May 2nd, from 7 to 10 p.m., the Second Part, on Sections 5-7, on Saturday, May 4th, from 2.30 to 6.30 p.m. The fee for Examination in either Division is *Two Shillings and Sixpence*.

The Final Examinations, in both Divisions, will be held on the following dates :—General Examination, Saturday, April 27th, 2.30 to 6.30 p.m. Section A, Saturday, May 4th, 2.30 to 6.30 p.m. ; Section B, Saturday, May 11th, 2.30 to 6.30 p.m. The fee for Examination in either Section of either Division is *Two Shillings and Sixpence*, in both Sections of either Division, *Four Shillings*.

**II. Full Technological Certificate.**—For the Full Technological Certificate, Division I. or II., Section A, the Candidate must have passed the Examinations in all three Grades, and must qualify as stated in Rules 29 and 30, but certificates showing that he has passed the Examinations of the Board of Education, in Geometrical as well as in Freehand or Model Drawing, will be accepted in lieu of one of the Science Certificates.

For the Full Technological Certificate, Division I. or II., Section B, Candidates must have passed the Final Examination, and hold the Institute's certificate in Wool Dyeing, Grade I, and in Woollen or Worsted Spinning (Final), and also have passed the Examinations of the Board of Education in Machine Drawing, and Stage II. Mathematics.

**III. Works of Reference.**—Watson, "Art of Weaving" (2nd edition, Glasgow, 1873) ; Ashenhurst, "Weaving and Designing of Textile Fabrics" (Bradford, 1888) ; Ashenhurst, "Design in Textile Fabrics," (Cassell & Co., 1883) ; Ashenhurst, "Textile Calculations and Structure of Fabrics" ; "Calculations on Yarns and Fabrics," by F. Bradbury ; Murphy, "Art of Weaving," ; "The Construction of the

Power Loom, and the Art of Weaving," Alex. Brown (Fourth Edition); "Loom Tuning," by James Bailey; "The Textile Educator" (Huddersfield, Broadbent & Co.); "Woollen and Worsted Cloth Manufacture," and "Colour in Woven Design" (G. Bell & Sons), by R. Beaumont; "The Finishing of Textile Fabrics," by R. Beaumont (Scott, Greenwood); Barlow's "History and Principles of Weaving"; "Cours de Tissage," by E. Gand; Posselt's "Technology of Textile Design"; "Woven Fabrics at the World's Fair," by R. Beaumont; "Weaving Mechanism," by T. W. Fox; "Ornamental Design for Woven Fabrics," by C. Stephenson and F. Suddards, (Methuen & Co.); "Textile Manufacturers' Book-keeping," by G. P. Norton, A.C.A. (Hamilton, Adams & Co., 1889); "Colour Harmony and Contrast," by James Ward (1903); "Laine cardée," by Alcan; "Manufacture of Woollen and Worsted," by Lister (Simpkin, Marshall & Co.); "Practical Fabric Structure," by Neville; "Yarns and Textile Fabrics," by J. Hertzfeldt; "The Jacquard Machine," by Posselt; "Colour," by Chevreul; "Science of Colour Mixing," by Patterson; "Pattern Analysis," and "Introduction to the Study of Textile Design," by A. F. Barker; "Grammar of Textile Design," by H. Nisbet (Scott Greenwood); "How to make a Woollen Mill Pay," by Mackie (Scott, Greenwood & Co.); "Faults in Woollen Goods," by N. Reiser (Scott, Greenwood & Co., 1904); "The Scottish Clans and Their Tartans" (W. & A. K. Johnston); "Carpet Manufacture," by F. Bradbury (1904); "Pattern Design," by Lewis F. Day (Batsford, 1903); "Japanese Textiles," by M. P. Verneuil (Batsford, 1910).

## 27.—COTTON SPINNING.

The course of instruction is intended to cover at least three years. Each year's work is indicated in the following syllabuses, which form a continuous and progressive course of study, and also define the subjects upon which the Examination questions will be founded.

Before entering upon the First Year's course of instruction in the Technology of the subject, all students are recommended to attend a preliminary course of lessons, covering a period of two years, in English, Arithmetic, Drawing and General Elementary Science, and the qualifications of each student as regards these preliminary subjects must be submitted to the Institute at the commencement of the session. No candidate under 20 years of age will be admitted to the First year's Examination, who is unable to produce evidence of having acquired the necessary knowledge of these subjects, prior to his admission to the First Year's course of Technological instruction.

The holding of the preliminary Technical Certificate, issued by the Union of Lancashire and Cheshire Institutes, or by the Midland Counties Union, or by the West Riding County Council, provided that the optional subject taken in each case is Experimental



Mechanics and Physics, or the Preliminary Technical Certificate of the National Union of Teachers, or the passing, prior to the commencement of the students' Technological Course, of an examination held under the direction of the Local Education Authority or the School Authority on a syllabus which has been approved by the Institute, will be accepted as evidence. Other evidence for consideration must be submitted at the commencement of the Session.

Candidates from Centres in Scotland will be admitted to the examination provided they satisfy the Scotch Education Department that they have received the necessary preliminary training.

1. Syllabus.—The Examinations will include questions founded on the following subjects :—

#### GRADE I.

1. The geographical positions of the cotton-fields of the world ; the area within which cotton can be commercially cultivated ; the physical conditions necessary to its growth and their influence upon the character of the fibre.

2. The preparation of cotton for the market ; ginning and packing ; the construction of gins and their operation : the proportions of lint and seed ; the influence upon the marketed fibre of faulty ginning and packing.

3. The physical properties of cotton ; structure, length, diameter, colour of different varieties ; classes and counts of yarn for which each variety is suitable.

4. The objects of cotton mixing ; the methods of mixing, and the construction and operation of the machines used for the purpose.

5. The principles of cotton cleaning ; the construction and working of opening and scutching machinery ; the functions of the various parts ; accessory apparatus used in connection with the machines.

6. The principles of cotton carding ; the characteristics of the machines used ; the construction and operation of carding machines ; the functions of the different parts ; the construction of the clothing used ; methods of grinding and stripping ; accessory appliances.

7. All calculations in connection with the above-named machines.

The Examination will be held on Monday, April 29th, from 7 to 10. The fee for the Examination is *One Shilling*.

No Certificates will be given on the results of the Examination in Grade I, but the Candidates' successes will be notified to the centre at which they were examined.

## GRADE II.

*Certificates will be issued to those Candidates only who have passed the Examination in Grade I in the same or a previous year.*

Candidates by permission of their Teachers, may enter in the same year for the Examinations in both Grade I and Grade II.

1. The principles of sliver drawing ; the objects aimed at ; the construction and operation of drawing machines.

2. The preparation of slivers for combing ; the machines used for that purpose. The objects of combing ; the construction of combing machines and their action.

3. The mode of producing rovings ; the construction and action of the machines used ; the functions and operations of the various parts ; variations in the construction of the different machines in the series ; accessory appliances.

4. The methods of twisting rovings and the essential features of good yarn.

5. The construction and action of the mule ; definition of the stages of the entire operation ; the functions of the principal parts of the machine ; the effect of each stage upon the material ; the methods of driving mules.

6. The construction of ring and flyer spinning frames and their operation ; the principles of their action ; the varieties in construction of different parts ; the bobbins used.

7. Calculations of speeds, drafts, twist, &c., in connection with the above machines, and the determination of the counts of yarns.

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The Examination will be held on Tuesday, April 30th, from 7 to 10. The fee for the Examination is *One Shilling and Sixpence*.

## FINAL EXAMINATION.

*Candidates for the Final Examination must hold a Certificate in Grade II.*

The Final Examination consists of two Sections, A and B. Section A refers to Cardroom processes ; Section B to Spinning and subsequent processes.

Candidates may enter for either Section or for the two Sections in the same year, and Certificates will be granted on the results of the Examination in each Section.

Mechanics and Physics, or the Preliminary Technical Certificate of the National Union of Teachers, or the passing, prior to the commencement of the students' Technological Course, of an examination held under the direction of the Local Education Authority or the School Authority on a syllabus which has been approved by the Institute, will be accepted as evidence. Other evidence for consideration must be submitted at the commencement of the Session.

Candidates from Centres in Scotland will be admitted to the examination provided they satisfy the Scotch Education Department that they have received the necessary preliminary training.

**I. Syllabus.**—The Examinations will include questions founded on the following subjects :—

### GRADE I.

1. The geographical positions of the cotton-fields of the world ; the area within which cotton can be commercially cultivated ; the physical conditions necessary to its growth and their influence upon the character of the fibre.

2. The preparation of cotton for the market ; ginning and packing ; the construction of gins and their operation : the proportions of lint and seed ; the influence upon the marketed fibre of faulty ginning and packing.

3. The physical properties of cotton ; structure, length, diameter, colour of different varieties ; classes and counts of yarn for which each variety is suitable.

4. The objects of cotton mixing ; the methods of mixing, and the construction and operation of the machines used for the purpose.

5. The principles of cotton cleaning ; the construction and working of opening and scutching machinery ; the functions of the various parts ; accessory apparatus used in connection with the machines.

6. The principles of cotton carding ; the characteristics of the machines used ; the construction and operation of carding machines ; the functions of the different parts ; the construction of the clothing used ; methods of grinding and stripping ; accessory appliances.

7. All calculations in connection with the above-named machines.

The Examination will be held on **Monday, April 29th**, from 7 to 10. The fee for the Examination is *One Shilling*.

No Certificates will be given on the results of the Examination in Grade I, but the Candidates' successes will be notified to the centre at which they were examined.

## GRADE II.

*Certificates will be issued to those Candidates only who have passed the Examination in Grade I in the same or a previous year.*

Candidates by permission of their Teachers, may enter in the same year for the Examinations in both Grade I and Grade II.

1. The principles of sliver drawing; the objects aimed at; the construction and operation of drawing machines.

2. The preparation of slivers for combing; the machines used for that purpose. The objects of combing; the construction of combing machines and their action.

3. The mode of producing rovings; the construction and action of the machines used; the functions and operations of the various parts; variations in the construction of the different machines in the series; accessory appliances.

4. The methods of twisting rovings and the essential features of good yarn.

5. The construction and action of the mule; definition of the stages of the entire operation; the functions of the principal parts of the machine; the effect of each stage upon the material; the methods of driving mules.

6. The construction of ring and flyer spinning frames and their operation; the principles of their action; the varieties in construction of different parts; the bobbins used.

7. Calculations of speeds, drafts, twist, &c., in connection with the above machines, and the determination of the counts of yarns.

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The Examination will be held on Tuesday, April 30th, from 7 to 10. The fee for the Examination is *One Shilling and Sixpence*.

## FINAL EXAMINATION.

*Candidates for the Final Examination must hold a Certificate in Grade II.*

The Final Examination consists of two Sections, A and B. Section A refers to Cardroom processes; Section B to Spinning and subsequent processes.

Candidates may enter for either Section or for the two Sections in the same year, and Certificates will be granted on the results of the Examination in each Section.

*Section A.*

## CARDROOM PROCESSES.

1. The terms and conditions on which raw cotton is bought ; the method of selecting it when purchasing ; the defects usually existing, and their effect upon the value. Tests for the moisture in cotton, and the permissible limit. The commercial purpose of mixing cotton. Testing of cotton for all usual purposes, at all processes in a cotton-spinning mill, up to and including fly-frames

2. The erection, repair, adjustment, practical manipulation, and general maintenance in good working order of all machines and accessories involved in cotton-spinning, up to and including fly-frames.

3. The construction of all machines referred to in paragraph 2.

4. Cost of production, labour charges, and advanced calculations on the machinery and processes involved.

5. The character and quantity of waste produced in the working of the machines, and its utilisation. The construction, use, and manipulation of the machinery required in the preparation of cotton waste for spinning.

6. The selection, drafting, specification, methods of driving, proportioning, practical mill arrangements, setting-out, and starting-up of all machines required in a cotton-spinning mill for the preparation of all qualities, counts, and descriptions of cotton roving.

7. The material, operations, and apparatus involved in roller-covering ; the preparation of drawing rollers for work and the accessory appliances used.

*Section B.*

## SPINNING AND SUBSEQUENT PROCESSES.

1. The production of doubled yarns ; the machinery used. The preparation of yarn for doubling ; the characteristics of each variety. The modes of treating doubled yarn for different purposes, and the machinery employed therein. Thread manufacture.

2. The production of fancy cotton yarns, such as cork-screwed, knop, and flake threads.

3. The uses to which cotton yarn is put ; the characteristics required for each purpose. The methods of making up yarns for various markets ; reeling and bundling machinery. Winding and warping.

4. The terms and conditions of sale of yarn. Conditioning of yarn. Defects in yarn and their remedies. The testing of cotton yarns for all purposes.

5. The erection, repair, adjustment, practical manipulation and general maintenance in good working order of all machines used in spinning and subsequent processes.

6. The operations of winding and warping and the machinery employed therein.

7. Quantities and character of waste made and the utilisation of such waste. The final processes in the spinning of waste, and the machines required. The character of the yarns produced, and the purposes for which they are suitable.

8. The selection, drafting, specification, proportioning, methods of driving, practical mill arrangement, setting-out and starting-up of all machines employed in spinning and subsequent processes.

9. The construction of all machines employed in the processes to which Section B refers.

10. Cost of production, labour charges, and advanced calculations on the machinery and processes employed.

11. Methods of lighting, heating, humidifying, ventilating, and fire prevention and extinction.

The Examination will be held on Tuesday, April 30th, from 7 to 10 in Section A, and on Wednesday, May 1st, from 7 to 10 in Section B. The fee for the Final Examination in either Section is *Two Shillings and Sixpence*.

**Vivâ Voce Test.**—Candidates for the Final Examination reaching a certain standard of proficiency at the Written Examination in Section B will be required to undergo a *vivâ voce* Examination, with the view of determining the award of the Institute's Prizes and of the Scholarships offered by the Lancashire County Council. The Prizes and Scholarships will be awarded on the results of the Examination in Section B, to those Candidates only who have previously, or in the same year, passed the Examination in Section A.

The *vivâ voce* Examination will be held as soon as possible after the Written Examination.

**II. Full Technological Certificate.**—For the Full Technological Certificate in either Section, the Candidate must have passed the three Examinations, and must qualify as stated in Rules 29 and 30, but certificates showing that he has passed the Examinations of the Board of Education in Geometrical as well as in Freehand or Model Drawing will be accepted in lieu of *one* of the Science Certificates.

**III. Works of Reference.**—"The Student's Cotton Spinning," by Joseph Nasmith, Manchester; "Cotton Spinning," by W. S. Taggart, Vols. I., II., III. (Macmillan and Co. Ltd., London); "The Elements of Cotton Spinning," by John Morriss and F. Wilkinson (Longmans, Green and Co.); "Cotton," by C. P. Brooks (E. and

F. N. Spon, London); "The Cotton Fibre; its Structure, &c.," by Hugh Monie, Junr. (John Heywood, Manchester); "Draw and Fly Frames," by Thomas Thornley (Abel Heywood and Sons, Manchester); "Structure of the Cotton Fibre," by F. H. Bowman (Palmer and Howe, Manchester); "Recent Cotton Mill Construction," by Joseph Nasmith (John Heywood, Manchester); "Cotton Spinning Calculations," by Thomas Thornley (John Heywood, Manchester); "Spinning calculations and yarn costs," by J. Winterbottom (Longmans, Green and Co.); "Self-acting mules" vols. 1 & 2, by Thomas Thornley (John Heywood, Manchester); "Cotton Combers," by Thomas Thornley (Scott, Greenwood); "Epicyclic Trams," by W. Bailey (Marsden, Manchester); "The Plain Series of Cotton Spinning Calculations," by W. H. Cook, Manchester; "Textile Manufacturer," "Textile Recorder," "Textile Mercury," all Manchester; "Cotton Facts (Yearly Statistics)," A. B. Shepper-son, New York.

*The above works are of recent date. The following may be advantageously studied, but are not to be accepted as representing present-day practice in all details. All but the first three are out of print, and can only be obtained second-hand.*

"Cotton Spinning, its Development, Principles and Practice" by Richard Marsden (Geo. Bell and Sons, London); "Cotton Spinning and Manufacture" (2 vols.), by Dr. Ure (Geo. Bell and Sons, London); "Cotton Trade of Great Britain" (History and Statistics), by Thos. Ellison (Effingham Wilson, London); "Modern Cotton Spinning," by Evan Leigh; "Modern Cotton Spinning Machinery," by Joseph Nasmith; "Theory and Practice of Cotton Spinning," by James Montgomery; "Cotton and its Treatment," by John Butterworth; "The Culture and Commerce of Cotton in India and elsewhere," by Dr. Forbes Royle; Tenth Census Report of the United States Government, a special volume on "Cotton Culture," edited by Prof. Hilyard; "Le Specie dei Cotoni," by F. Parlatore; "History of Cotton," by E. T. Donnell.

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## 28.—COTTON WEAVING.

The course of instruction is intended to cover three years. Each year's work is indicated in the following syllabuses, which define the subjects upon which the Examination questions will be founded.

Before entering upon the first year's course of instruction in the Technology of the subject, all students are recommended to attend a preliminary course of lessons, covering a period of two years, in English, Arithmetic, Drawing and General Elementary Science, and the qualifications of each student as regards these preliminary subjects must be submitted to the Institute at the commencement of the session. No candidate under 20 years of age will be

admitted to the Examination in Grade I, who is unable to produce evidence of having acquired the necessary knowledge of these subjects, prior to his admission to the first year's course of technological instruction.

The holding of the Preliminary Technical Certificate, issued by the Union of Lancashire and Cheshire Institutes, or by the Midland Counties Union, or by the West Riding County Council, provided that the optional subject taken in each case is Experimental Mechanics and Physics, or the Preliminary Technical Certificate of the National Union of Teachers, or the passing, prior to the commencement of the Student's Technological Course, of an examination held under the direction of the Local Education Authority or the School Authority on a syllabus which has been approved by the Institute, will be accepted as evidence. Other evidence for consideration must be submitted at the commencement of the Session.

Candidates from Centres in Scotland will be admitted to the examinations provided they satisfy the Scotch Education Department that they have received the necessary preliminary training.

I. Syllabus.—The Examinations will include questions founded on the following subjects :—

#### GRADE I.

1. The systems of counting cotton, worsted, woollen, linen and silk yarns.
2. Calculations relating to the testing of counts, the folding of, and conversion to, equivalent counts of the above yarns.
3. The different forms in which cotton yarns may be supplied to the manufacturer, as in cops, on ring bobbins, in hanks, in cones, in balled warps, and upon warper's beams.
4. Standard weaves as plains, twills, satins, and their derivatives; also including honeycomb, huckaback, corkscrew, crepe, and similar weaves, requiring not more than 16 shafts. The construction of patterns by combination and re-arrangement.
5. The designing of small fancy weaves requiring not more than 20 shafts and arranged in the form of stripes, spots, and all over-effects. The development of such weaves by the introduction into the warp of coloured yarns, also by extra warp, crammed dents, and varied counts.
6. The structure of fustian fabrics; also of cotton cords and velveteens and the methods of cutting them.
7. The structure of Bedford cords and also of single weft fabrics in which extra warp is used to develop the pattern, and in piques and welts.



8. The dissection of all types of fabrics specified in this course, in order to determine the methods of interweaving, also drafts, and peg plans for the same.

9. Different methods of counting the healds and reeds used in the cotton manufacturing districts; also heald knitting, and casting-out calculations.

10. Calculations necessary in order to ascertain the amount of warp or weft required to produce a certain quantity of cloth from specified particulars.

11. The hand loom mounted with treadles or dobbies. Its advantages for pattern production.

12. The power loom. Shedding by means of tappets and dobbies. Tappet construction. The principles of under and top rollers applicable to the same. The mechanism of a single box, fast or loose reed, cone pick loom. The timing and setting of parts, and calculations relating to the same.

13. The rope, or chain and lever letting-off motion. Ordinary taking up motions. Shuttles, pickers, picking bands, check and buffer straps, and temples of various makes and arrangements.

The Examination will be held on Saturday, May 4th, from 2.30 to 6.30. The fee for the Examination in Grade I is *One Shilling*.

No Certificates will be granted on the results of the Examination in Grade I, but the Candidates' successes will be notified to the centres at which they were examined.

## GRADE II.

*Certificates will be issued to those Candidates only who have passed the Examination in Grade I in the same or a previous year.*

Candidates, by permission of their Teachers, may enter in the same year for the examinations in both Grade I and Grade II.

The Examination will be based upon the following subjects :—

1. The structure of brocades made from one or more wefts, also of diapers, and one sided and reversible damasks.

2. The structure of fabrics made from two warps and two wefts, as fast backed piques, welts, toiles, patent satins, matelasses; also all types of warp and weft backed fabrics.

3. The structure of, and development of pattern in, compound fabrics of two or more warps and wefts, as in tapestries and figured repps.

4. Designing for lappet and swivel fabrics and the mechanical contrivances for producing such designs.

5. The structure of gauze or leno fabrics and Madras muslins, and the methods of weaving them.

6. The structure of terry fabrics and their ornamentation by variation of weave or colour.

7. The structure of figured velveteens and cords, also of looped and cut pile fabrics.

8. The analysis of all fabrics which are included in this course, in order to determine particulars of structure, such as weave, reed, pick, draft, &c., but not counts of yarn.

9. Multiple Shuttle Box motions.

10. The various makes of jacquards, as single lifts, centre shed, double lift with single or double cylinders, and open shed. Stop motions applicable to the same.

11. The special advantages of jacquard mountings when combined with healds, as used in striped designs, and for quiltings, alhambras, compound, and other fabrics.

12. Methods of adapting jacquard harnesses to suit different reeds, and calculations for the same.

13. Calculations to ascertain the weight of material required for the fabrics mentioned in this course.

The Examination will be held on **Saturday, May 11th**, from 2.30 to 6.30. The fee for the Examination in Grade II is *One Shilling and Sixpence*.

### FINAL EXAMINATION.

*Candidates for the Final Examination must hold a Certificate in Grade II.*

The Final Examination consists of two Sections, (A) the application of Design and Colour to Woven Textiles, (B) the manufacture of Woven Textiles.

#### *Section A.*

#### APPLIED DESIGN.

The Examination will be written and practical.

(1.) **Written Examination.**—The Examination may include questions founded on the following subjects :—

1. The nature and properties of the different fibres used for manufacturing processes and the methods of distinguishing one from another.

2. The limitations of, and influence upon, ornamentation imposed by the nature of the materials and the mechanisms which may be employed.

3. Elementary principles of colour. The primaries and their derivatives. Juxtaposition of colour. Limitations and changes due to interweaving coloured threads. Practical application of colour to striped, checked and figured fabrics. Colour matching from yarns, cloth, and natural objects.

4. Pencil drawings and painted designs which may be produced by means of tappets and dobbies.

5. Trade methods of preparing original sketch designs for jacquard figured effects, the transfer of such designs to point paper. The use and objects of various rulings of design paper.

6. The application of design to figured velveteens and cords, also to all looped and cut pile textures. The influence of jacquard and harness upon the procedure.

7. The application of design to all kinds of compound fabrics (*a*) when ordinary jacquards and harnesses are employed, (*b*) when special jacquards and harnesses are employed.

8. The application of design to brocade, tapestry, and repp fabrics, also the creation of texture involved by such application. The modifications imposed by jacquard, harnesses, and stitching warps and wefts.

9. The application of design to jacquard gauze, modifications of methods due to the type and position of jacquard machines, also to harnesses employed, and to top and bottom douping.

10. Card-cutting instructions for the designs included in Sections 5, 6, 7, 8 and 9.

11. Cutting of cards from designs. Card repeating machines, and manual and mechanical card lacing.

12. The planning of tie-ups for jacquard harnesses.

13. The selection of suitable yarns, reeds, and picks for typical fabrics mentioned in this and the preceding courses.

14. Analysis of all fabrics included in this course. Candidates, when dissecting the woven specimens, may use samples of yarns and a fine balance with a view to determining the "counts" of the yarns correctly.

The written Examination in Section A, Applied Design, will be held on **Saturday, May 4th**, from 2.30 to 6.30. Candidates should be provided with pencils, water colours, and brushes. The fee for the Examination, Written and Practical, is *Two Shillings and Sixpence*.

(2.) **Practical Work.**—Each Candidate in Applied Design will be required to forward to the offices of the Department, Exhibition Road, London, S.W., by April 29th, a collection of woven samples illustrating colour combinations and weave effects. Each sample must be at least six inches wide by twelve inches long, or of sufficient length to show adequately a few repeats of the design, and each Candidate must submit two specimens from each of six, or three from each of four, of the undermentioned groups (twelve specimens in all).

Group 1. Original weaves suitable for fabrics intended to be bleached, such as may be used for underclothing, bed drapery, table covers, and window curtains.

Group 2. All classes of coloured and fancy shirtings.

Group 3. Blouse and dress materials suitable for summer wear, including mock and leno effects.

Group 4. Blouse and dress materials of heavier textures and darker colourings than those included in Group 3, and intended for winter wear.

Group 5. Heavy cotton textures, such as towellings, bath sheets, dressing gowns, striped and checked blankets, and rugs.

Group 6. Skirtings, spotted vestings, backed trouserings, fancy cords and velveteens, and other textures intended for clothing.

Group 7. The specimens submitted for this group must be confined to fabrics in which the pattern is produced by stitching a tight warp into a slack cloth, as in piques, welts, toiles, matelasses, and other similar structures, both white and coloured.

Group 8. This group includes all fabrics in which two or more figuring warps or figuring wefts are employed, as in tapestries and repps.

Group 9. This group includes all fabrics in which some of or all the warp threads do not lie parallel to each other, as in leno, lappet, and warp pile fabrics.

Group 10. This group includes all fabrics composed of two warps and two or more wefts used to form interchangeable fabrics, equal or unequal in structure and bound together or otherwise, as in Scotch carpets, patent satins, or other compound fabrics.

Group 11. This group includes all fabrics in which pattern is produced by a figuring warp or weft, as in Dhooties, apron cloths, skirtings, Alhambras, and swivels.

Group 12. This group includes all fabrics of one warp and one weft, such as brocades, diapers, damasks, and other similar structures.

Each candidate's work must be accompanied by a certificate signed by his employer, or by the class teacher and a member of the

School Committee, stating that the design has been produced by the Candidate, and the work has been executed by him without assistance.

Forms of Certificate and printed forms with instructions, on which particulars of woven samples should be written, may be had on application to the Institute.

### *Section B.*

#### COTTON MANUFACTURING.

The Examination will be based upon the following subjects :—

1. Machines for winding from cops, bobbins, cones, cheeses, hanks, or warps, to warper's bobbins, or to pirn bobbins, or tubes.

2. Warping and warping machinery, beam warping, chaining, mill warping, sectional warping, with the necessary calculations relating to the machines and processes.

3. Sizing and sizing machinery. Size ingredients, their respective purposes; their chemical action upon each other and upon the threads. Size mixing, and machinery for the same. Sizing, brushing, stretching, and drying of hanks; also the dresser sizer, the ball sizer, the slasher sizer. Steam *versus* hot or cold air systems of drying. Calculations relating to the foregoing.

4. Scotch dressing and long chain beaming for coloured goods. Yorkshire dressing. The beaming of warps. Drawing-in, twisting or looming, and gating the warp.

5. The relative manufacturing advantages of yarns made from dyed raw cotton and sliver; also when dyed in the cop, cone, cheese, hank, back beam and warp.

6. The selection and productiveness of preparatory and weaving machinery for specified classes of work, such as plain, twill, checked and fancy cloths, in any practical combination.

7. Jacquard machines of special build, such as twilling, cross border, leno, pile and twin machines. Setting out, building, and dressing harnesses for gauze, tapestry, compound and pile textures. Also scale and pressure harnesses.

8. Picking mechanism other than the cone; taking-up and warp delivery motions for both regular and irregular wefting. The centre weft fork. Automatic weft supply mechanism. Warp stop and motions.

9. Approximate speeds and adjustments of the machinery mentioned in this course. The defects likely to occur at each process, and the methods of correcting them.

10. The methods of testing yarns for fibrous matters, for count, strength, regularity, moisture, foreign matters and defects. Cloth

testing, to ascertain weave, count, reed, pick, strength, elasticity and percentage of foreign matter.

11. Calculations relating to cloth structures. The estimation of the counts of yarns. The costing of cloth, including wages, departmental and other expenses.

12. Defects in fabrics caused by faulty preparation of the yarns, or faulty manipulation in the loom, and by unequal balancing of the warp and weft.

13. The most desirable situation for a weaving mill ; the best and most economical forms of lighting, heating, ventilating, and humidifying mill buildings, and the selection, arrangement, and driving of machinery with a view to producing the most economical results. Methods of guarding against accidents peculiar to manufacturing. Provisions against fire, such as sprinklers, fire-proofing, and general care.

The Examination in Section B will be held on Saturday, May 11th, from 2.30 to 6.30 p.m. The fee for the Examination is *Two Shillings and Sixpence*. The fee for Candidates taking both Sections A and B in the same year is *Five Shillings*.

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**Vivâ Voce Test.**—Candidates for the Final Examination reaching a certain standard of proficiency at the Written Examination will be required to undergo a *vivâ voce* examination, with a view of determining the award of the Institute's prizes, and of the Scholarships offered by the Lancashire County Council ; in the award of at least one of the Scholarships, preference will be given to Candidates who may have passed in the same, or in a previous, year in Grade I of Subject 72.

The *vivâ voce* examination will be held as soon as possible after the Written Examination.

**II. Full Technological Certificate.**—For the Full Technological Certificate, the candidate must have passed the Examinations in all three Grades, and must qualify as stated in Rules 29 and 30, but certificates showing that he has passed the Examination of the Board of Education in Geometrical Drawing, as well as in Freehand or Model Drawing, will be accepted in lieu of one of the Science Certificates.

**III. Works of Reference.**—See lists of books under 26, "Woollen and Worsted Weaving," and 72, "Principles of Art as applied to the Design of Patterns for Weaving."

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## 29.—FLAX SPINNING.

I. Syllabus.—The Examination will include questions founded on such subjects as the following :—

## GRADE I.

1. *Flax Fibre*.—Principal flax-growing countries ; requirements of temperature and climate ; suitable soil ; choice of seed ; sowing ; weeding ; pulling, retting and grassing the flax straw ; modern improvements in flax retting ; breaking the flax straw ; hand and mill scutching ; Irish and Continental methods ; scutching tow.

2. *Flax Hackling*.—Roughing and piecing out ; object of roughing ; cut line ; hackling machines ; tipples ; sorting.

3. *Tow Carding*.—Object of carding ; speeds of the different organs of the card ; setting the rollers ; advisability or otherwise of the addition of a drawing-head.

4. *Flax and Tow Preparing*.—Objects of drafting and doubling ; screw gill and push-bar frames ; maximum speed of fallers ; the object of the differential motion in the roving-frame ; set, draft and bell calculations ; changing the index, twist and builder pinions of the roving-frame.

5. *Flax and Tow Spinning*.—Wet, dry and half-dry systems ; roller fluting ; different methods of roller cleaning ; draft and twist calculations ; reaches ; set of frame ; dragging the bobbin.

6. *Reeling and Bundling*.—Difference between long and short reel ; use, and proper position, of shifter on reel ; stripping arrangements ; power reel drive ; bell motion ; cross leasing ; weight of moisture absorbed by dry yarn under atmospheric conditions.

7. *Historical and General*.—History of the trade ; effect of the different mill operations on the health of the workpeople.

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FINAL EXAMINATION.

In the Final Examination more difficult questions will be set in the above subjects, and, in addition, a knowledge will be required of :—

1. *Plant*.—Physical, chemical, and botanical characteristics of the flax plant ; weight and germinating power of seed ; seed saving ; value of flax straw "on foot" ; manures ; farmers' profits.

2. *Retting*.—Chemical theory of retting ; selection of suitable water ; value of double retting ; dew and water retting ; mixed retting ; co-operative retting.

3. *Breaking and Scutching*.—Modern breaking and scutching machinery ; necessity for careful handling.

4. *Flax Trade*.—Russian flax marks and their comparative values; Continental weights and moneys; trade terms and usages.

5. *Flax Hackling*.—Theory of hackling; long and cut line; gradation and grouping of tools on hackling machines; calculations as to yield; average lea and cost of dressed line; costs of hackling; cheaper hackling.

6. *Tow Carding and Combing*.—Breaker and finisher cards, their arrangement; sizes; number of rollers and doffers; length and angle of pins; fineness of clothing; filleting *versus* wood-covering; card feeding arrangements; drawing-heads; tow combing machine and combing; percentage of noil.

7. *Flax and Tow Preparing*.—Theory of reaches, drafts and doublings; the differential motion in theory and practice; theory of the formation of cones and other organs of variation for the differential motion; cost of preparing; number of spinning spindles a roving spindle is capable of supplying on different materials, qualities, and counts; details of preparing machinery; heavy spreading; compound systems; automatic stop motions and independent heads; cheapening preparing; undressed flax sliver combing; humidification and ventilation of carding and preparing rooms.

8. *Flax and Tow Spinning and Twisting*.—Gill spinning; hot and cold water spinning; dry and demi-sec spinning; ring spinning; "lines" of the spinning frame; setting the breast-beam and tin rod of the dry spinning frame; proportions of spindle, bobbin and flyer; spinning yarn in cop form; automatic lubrication of spindles; automatic dragging. *Thread Spinning and Twisting*.—Principles of doubling and twisting; theory of reverse twist; rules for twisting thread yarns, and threads (*a*) for use in the grey and (*b*) for use in the various bleached and dyed shades. Shoe yarn and thread for sole sewing in machines; cabled threads.

9. *Reeling and Bundling*.—Difference between "weavers" and "over-thumb" knots; cross reeling; thread spooling; cop winding; Irish, Scotch and Continental yarn tables; Continental import duties on yarns and threads; yarn drying and cooling.

10. *Mill Management*.—The Factory Acts and "Special Rules" relating to Flax Spinning; accident prevention and ventilation of flax mills; spinning waste and cost of production; proportions of hackling, preparing and spinning; cost of machinery; H.P. required to drive the different machines employed; arrangement of a flax-spinning mill; cost of producing linen yarn as compared with cotton.

11. *Historical and General*.—Names of the principal inventors, ancient and modern, of machinery employed in, or adapted to, flax-spinning; flax-spinning centres; approximate number of spinning spindles in the various flax-spinning countries; hours of labour on the Continent; flax and yarn imports into Great Britain and Ireland.



The Examination in both Grades will be held on Tuesday, April 30th, 7 to 10 p.m. The fee for the Examination in either Grade is *One Shilling and Sixpence*.

**II. Full Technological Certificate.**—For the Full Technological Certificate, the candidate will be required to qualify as stated in Rules 29 and 30, but Certificates showing that he has passed the Examinations of the Board of Education in Geometrical Drawing, as well as in Freehand or Model Drawing, will be accepted in lieu of one of the Science Certificates.

**III. Works of Reference.**—"Flax and its Products in Ireland," by W. Charley, J.P. (London: Bell & Daldy, 1862); "The Raw Material of the Linen Trade," by J. F. Hodges, M.D. ("Practical Mechanics' Journal," 1862); "Reports on the Economy of the Flax Plant," in Reports of the British Association, by J. F. Hodges, M.D. (1852); "Flax, its Cultivation and Preparation," by James Ward; "The Culture and Preparation of Flax," by Michael Andrews (Flax Supply Association, Belfast); "The Flax and Tow Spinner's Calculator," by W. Pickles (Simpkin, Marshall & Co., London); Hofmann's "Bericht," Third Part (Friedrich Vieweg & Sohn, Braunschweig, 1877); The Sixth Edition of "Cooley's Cyclopædia of Practical Receipts," part ix., page 972 (J. & A. Churchill, London, 1878); "Flax, Tow, and Jute Spinning," by Peter Sharp; Marshall's "Practical Flax Spinner" (Emmott & Co., London and Manchester); "The Spinning and Twisting of Long Vegetable Fibres," by H. R. Carter (Griffin, 1904); "Modern Flax, Hemp and Jute Spinning," by H. R. Carter (Scott, Greenwood & Co., 1907).

### 30.—LINEN WEAVING.

The course of instruction is intended to cover three years. Each year's work is indicated in the following syllabuses, which form a continuous and progressive course of study, and also define the subjects upon which the Examination questions will be founded. Candidates before presenting themselves for the Examination in Grade I are recommended to attend a preliminary course of instruction in Arithmetic, Drawing, and Elementary Physics.

Candidates, by permission of their teachers, may enter in the same year for the examinations in both Grade I and Grade II.

**I. Syllabus.**—The Examinations will include questions founded on the following subjects:—

#### GRADE I.

1. Linen, cotton and jute yarns. The systems of counting. The forms in which these yarns are supplied to the manufacturer.

2. Warp and weft winding machinery. Cops and pirns, the advantages and disadvantages of each system.

3. Warping machinery; beam warping, mill warping and sectional warping. Beaming machinery.

4. Dressing. Ingredients used, and their respective purposes. Mixing machinery. The construction and operation of dressing machines.

5. Drawing-in and reeding.

6. The necessary calculations relating to the foregoing machines and processes.

7. Different methods of counting reeds and indicating the fineness of cloth in the weft, in the linen manufacturing districts.

8. Quantitative calculations in warp and weft from specified particulars.

9. Standard weaves requiring not more than five shafts, with the necessary drafts and weaving plans.

10. The power loom. Construction of a plain loom. Timing and setting of the parts, and calculations relating to same.

The Examination in Grade I will be held on **Monday, April 29th**, from 7 to 10 p.m. The fee for the Examination is *One Shilling*.

No Certificates will be granted on the results of the Examination in Grade I, but the Candidates' successes will be notified to the centres at which they were examined.

## GRADE II.

*Certificates will be issued to those Candidates only who have passed the Examination in Grade I in the same or a previous year.*

In this Examination questions will not be asked relating to the preparatory machinery or processes, but more advanced knowledge will be required regarding the construction and operation of power looms, and the principles underlying the various motions.

In addition, the Examination will include questions on the following subjects:—

1. The more elaborate weaves suitable for tappets and dobbies, with the exception of gauze. The construction of patterns by combination and rearrangement. The analysis of simple fabrics for design draft and weaving plan.

2. Negative and positive shedding tappets and their construction.

3. Various types of dobbie machines.

4. Jacquard machines. Single and double action, double cylindered and cross border machines; their general arrangement and method of driving.

5. Full harness mounting. Method of building and various ties.
6. Card cutting and repeating machines. Card lacing, hand and machine.
7. Revolving and drop box motions.
8. The hand loom, its construction and utility.

The Examination will be held on Tuesday, April 30th, from 7 to 10. The fee for the Examination is *One Shilling and Sixpence*.

### FINAL EXAMINATION.

*Candidates for the Final Examination must hold a Certificate in Grade II.*

The Final Examination consists of two Sections, A and B. Section A refers to Ornament and Designing as applied to Textiles, Section B to the Production of the Cloth and Mill Management.

The Examination in both sections will be Written and Practical, and the written Examination will consist of two parts, a general paper on Cloth Construction, Costing and Analysis, and a special paper on the subjects of Section A or B.

To obtain a certificate Candidates will be required to pass in the General Paper, and in either Section A or B. Students are recommended, however, to attend courses of instruction in both sections.

All Candidates will be required to show a knowledge of the preparatory processes and of the machinery and appliances necessary to conduct them, also of weaving machinery and appliances, and the principles of designing as defined in the first and second years' courses.

### *General Syllabus.*

1. The nature and properties of the different fibres used in weaving and the methods of distinguishing one from another. The suitability of linen yarn to combine with yarn of another fibre, as warp or weft, or as part of both.

2. Counts and cost of twisted or folded yarns.

3. Bleached and finished linen yarns. Object and result of the different treatments. Approximate loss in weight.

4. The selection of suitable yarns, reeds, picks and weaves for the usual run of linen fabrics.

5. Calculations relating to cloth structure, and to the preservation of the balance or texture and of the weight of the fabric.

6. Calculations involved in determining the weight and cost of a cloth, given the necessary particulars.

7. The analysis of linen fabrics for all data necessary for reproduction, including weave, quantities of yarns, counts of yarns, reed, picks, &c.

8. Special shedding mechanisms, such as twilling Jacquard machines and pressure harness. The benefits derived and defects resulting from their use.

9. Structure and analysis of Jacquard figured linen fabrics, and the general principles involved in designing for full harness and other mountings.

10. The elementary principles of gauze or leno weaving.

11. Centre selvage motions.

The Examination in the subjects of the General Syllabus will be held on Wednesday, May 1st, from 7 to 10 p.m.

#### *Section A.*

(1.) **Written Examination.**—The Examination will include questions on the following subjects:—

1. Various styles of ornament; their treatment and suitability for linen fabrics.

2. The arrangement of ornament to suit the purpose for which the fabric is intended.

3. Limitations imposed by the nature of the fabric, the nature of the design and the process of production.

4. The arrangement of design and mounting to admit of certain alterations in width or length of a cloth or napkin without breaking the pattern.

5. The preparation of designs for the different Jacquard machines, including the transfer of sketches to point paper, and the reasons for the various rulings of such paper.

Drawing or point paper will be supplied by the Institute if required, but all necessary instruments, &c., must be provided by the Candidates or the School.

(2.) **Practical Work.**—Each Candidate will be required to design, execute, and forward to London, not later than April 29th, a saleable linen damask or other article. The specimen must be accompanied by the original sketch showing the harness mounting and the card cutter's design, which must occupy not less than 300 threads by 300 picks.

Each Candidate's work must be accompanied by a certificate signed by his employer or by the class teacher and a member of the school committee, stating that the design has been produced by the candidate, and the work has been executed by him without assistance.

Forms of certificate, and printed forms with instructions, on which particulars of woven samples must be written, may be had on application.

The Examination in Section A will be held on Saturday, May 4th, from 2.30 to 6.30 p.m. The fee for the Examination is *Two Shillings and Sixpence*.

### *Section B.*

(1.) **Written Examination.**—The Examination will include questions on the following subjects :—

1. The selection of preparatory and weaving machinery for specified classes of work, such as plain or twill, checked and figured cloths.

2. The relative productive capacity of such machinery, and its mechanism in detail.

3. The adjustment of the parts of each machine for all ordinary work. The defects likely to occur at each process and their correction.

4. Cropping, measuring, and lapping machinery.

5. The methods of testing yarns for count, strength, twist, regularity, moisture.

6. The transmission of motive power; speed of shafting, and approximate speeds of looms for different widths and types of fabrics.

7. Arrangement of buildings and machinery with regard to economical working and oversight, natural and artificial lighting, ventilation, heating and humidifying. Provisions against fire, and general care.

8. Situations of weaving factories as to best atmospheric conditions, proximity to markets, supplies, etc.

Drawing paper will be supplied by the Institute if required. All necessary instruments, etc., must be provided by the Candidates or the School.

(2.) **Practical Work.**—Each Candidate will be required to design, execute, and forward to London, not later than April 29th, a collection of at least eight original woven specimens, illustrating such effects as may be produced by tappets or dobbies not exceeding 16 shafts. Each specimen to be at least four inches square, and to be accompanied by the designs, drafts, and weaving plans. The work must be accompanied by a Certificate as stated on page 143.

The Examination in Section B will be held on Thursday, May 2nd, from 7 to 10 p.m. The fee for the entire Examination is *Two Shillings and Sixpence*. For Candidates taking the Examination in both Sections A and B, the fee is *Four Shillings*.

**II. Full Technological Certificate.**—For the Full Technological Certificate, the Candidate will be required to qualify as stated in Rules 29 and 30, but Certificates showing that he has passed the Examinations of the Board of Education in Geometrical Drawing, as well as in Freehand or Model Drawing, will be accepted in lieu of one of the Science Certificates.

III. Works of Reference.—“Flax and its Products in Ireland,” by W. Charley, J.P. (Bell & Daldy, London, 1862); “The Culture and Preparation of Flax,” by Michael Andrews (Flax Supply Association, Belfast); “Cooley’s Cyclopædia of Practical Receipts,” 6th or 7th edition under “Linen” (J. & A. Churchill, London); “Flax, Tow, and Jute Spinning,” by Peter Sharp, 3rd Edition (James P. Mathew & Co., 17, Cowgate, Dundee, 1896); “Practical Flax Spinner,” by Leslie C. Marshall (Emmott & Co., London and Manchester, 1885); “Art of Weaving,” by John Watson, 3rd edition (George Watson & Son), 162, Ingram Street, Glasgow, 1888); “Weaving and Designing of Textile Fabrics,” by Thomas R. Ashenhurst, 5th edition (J. Broadbent & Co., High Street, Huddersfield, 1893); “Theory and Practice of Damask Weaving,” by H. Winzer and K. Walter (Scott, Greenwood & Co.); “The Construction of the Power Loom and the Art of Weaving,” by Alex. Brown, 7th edition (James P. Mathew & Co., 17, Cowgate, Dundee, 1896); “The Mechanism of Weaving,” by T. W. Fox (Macmillan & Co., London, 1894); “Jacquard Weaving and Designing,” by T. F. Bell (Longmans, Green & Co., London, 1895); “Jute and Linen Weaving,” by Thomas Woodhouse and Thomas Milne (Emmott & Co., London and Manchester, 1904); “Designing,” by T. Woodhouse and T. Milne (Textile Manufacturer, 1904); “Colour in Woven Design,” by Roberts Beaumont (Whittaker & Co., London, 1890); “Carpet Weaving,” by F. Bradbury; “Calculations in Yarns and Fabrics,” by F. Bradbury.

### 31.—SILK THROWING AND SPINNING.

The course of instruction is intended to cover two years. Each year’s work is indicated in the following syllabuses, which form a progressive course of study, and also define the subjects upon which the Examination questions will be founded. Candidates, before entering upon the first year’s course of instruction in the technology of the subject, are recommended to attend a preliminary course of instruction in arithmetic, drawing, and elementary physics.

I. Syllabus.—The examinations will include questions founded on the following subjects :—

#### GRADE I.

1. Definition. Origin and species of the principal insects known as silk spinners: Bombycidæ. Saturnidæ (Domestic and wild silk worms). Univoltines. Multivoltines.

2. Diseases to which silkworms are liable and their influence on the character of silk produced. Microscopical inspection.

3. General knowledge of the various classes of cocoons. Size and length of thread produced by the different species of silk spinners. Yield from a given quantity of seed or eggs.

4. Principles and methods of reeling—Desiccation by stoving or steaming—Cleaning the cocoon—Temperature. The *croisure*. Apparatus used. Comparison between methods of native and filature reeled silk.

5. The chief silk producing countries. Distinguishing characteristics of the silks produced; their uses and comparative values. General classification as to quality and grading.

6. Preparatory processes of silk throwing: tests for size of raw: test of winding quality: sizing: washing.

7. Machines used in throwing: winding, cleaning, doubling, spinning, hoisting, reeling (Grant and ordinary reel), and *dramming* or *deniering*.

8. Description of various kinds of spindles; speeds and methods of driving; traverse motions; comparison as to merits; calculation of wheels to produce given twists.

9. Faults to which thrown silks are liable, and remedies for such; application of thrown silk to manufacture of goods. The various kinds of silk threads, singles, *tram*, *organzine*, *sewings*: spin and throw best suited for different fabrics. Method of preparing, and silks best suited for weaving in the single thread.

10. Character and percentage of waste made in reeling silk from cocoon; character and quantity made in silk throwing; the adaptation of waste for silk spinning, preparation of knubs, husks and pierced cocoons, the processes of *schapping* and discharging waste silk.

The examination in both grades will be held on **Monday, April 29th, 7 to 10 p.m.** The fee for examination in either grade is *One Shilling and Sixpence*.

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#### FINAL EXAMINATION.

*Candidates for the Final Examination must hold a Certificate in Grade I.*

More advanced questions will be set in some of the subjects of the preceding course, and in addition a knowledge will be required of:—

1. Average annual production and exports of the chief silk-producing countries.

2. Physical, chemical and structural properties of the various kinds of silk fibre. The *brin* and *bave*, combination of cocoons

to produce a given size of thread. Elasticity; tenacity; methods of testing and normal standards of quality. Imperfections caused by faults in reeling.

3. Chemistry of silk fibres; the action of alkalies, acids, and other re-agents on the thread. Affinity of silk for weighting: the agents generally used and effect on the fibre.

4. The process of conditioning silk, raw and thrown. Preparation of silk threads for dyeing; methods of discharging the gum, percentage of loss in various classes of silk, nature of faults caused by over-boiling.

5. Artificial silk: composition and production: relative size in which reeled, and specific gravity in comparison with natural silk.

6. Method of calculating counts and sizes of silk yarns, raw, thrown, and spun silks; comparative nomenclature for drams, deniers and counts, with other textiles.

7. Dissection of a woven fabric to ascertain character and size (or denier) of the silk used; net or spun silk, or other textile fibres. [A practical test will be given for which a needle, count glass, pocket microscope and twist tester will be required.]

8. Characteristics of various classes of silk waste, length of drafts made in processes of preparing and dressing.

9. Methods of dressing and carding spun silk; top; sliver, drawing, roving, spinning and doubling frames; processes of gassing, reeling and finishing.

10. The several kinds of spun silk yarns; adaptation for various manufacturing processes; weaving; machine sewings; embroidery; lace; hosiery; Tussore and Noil yarns.

**II. Full Technological Certificate.**—For the Full Technological Certificate, the Candidate must qualify as stated in Rules 29 and 30, but Certificates showing that he has passed the Examinations of the Board of Education in Geometrical Drawing, as well as in Freehand or Model Drawing, will be accepted in lieu of one of the Science Certificates.

**III. Works of Reference.**—"The Wild Silks of India," by Sir T. Wardle (S. Kensington Museum, 1881); "On Silk," by Sir T. Wardle (Bumpus, 1887); "Tussur Silk," by Sir Thos. Wardle (W. Trounce, London, 1891); "Textile Raw Materials and their conversion into Yarns," by J. Lisper, translated from the German by C. Salter (Scott, Greenwood & Co.); Chambers's Encyclopædia, Article "Silk" by Sir T. Wardle, 1892; "British Manufacturing Industries, Wool, Cotton, Silk, &c.," by Bevan (Stanford, 1887); "The Tussur Silkworm," by Captain Coussmaker (Spon, 1873); "The Encyclopædia



of the Industrial Arts," Article "Silk" (Spon); "Silkworms," by E. A. Butler (Swan Sonnenschein, 1892); "The Dyeing of Textile Fabrics" (Articles on chemical composition of silk, &c.), by J. J. Hummel (Cassell, 1896); "Comparative Yarn Tables," by McLennan, Blair & Co. (J. R. Parlane, Paisley, 1883); "Dictionnaire de Séricologie," by G. Luppi (Méra, Lyons); "Cours de Sériculture," by Laurent de L'Arbousset (Castagnier Alais, 1893), also translated by Miss E. Wardle, and edited by Sir T. Wardle (W. H. Eaton, Leek); "The Divisibility of the Silk Fibre," by Sir T. Wardle (Heywood, Manchester); "La Soie," by L. Vignon (Baillié Fils, Paris, 1890); "Recherches sur la Soie," 1891, "Nouvelles Recherches sur la Soie," 1892, by L. Vignon (Baillié Fils, Paris); "Die Seide, ihre Geschichte," by Silbermann (Emmott & Co., Manchester); "The Chemical Technology of Textile Fabrics," by Dr. G. von Georgievics (Scott, Greenwood & Co., 1902); "Silk Throwing and Waste Silk Spinning," by H. Rayner (Scott, Greenwood, 1903).

**Journals.**—"Textile Mercury" (weekly, Marsden & Co., Manchester); "Textile Manufacturer" (monthly, Emmott & Co. Manchester); "Bulletin des Soies et des Soieries" (Georg, Lyons); "Bulletin du Moulinage" (Lyons); "Seide" (weekly, Mullemann & Bouse, Crefeld). *Annual*: Statistique de la Production de la Soie en France et à l'Etranger (Lyons: Alexandre Rey).

## 32.—SILK (INCLUDING RIBBON AND SMALLWARE) WEAVING.

The course of instruction in Silk Weaving is intended to cover two years, and to form a continuous course of study. The Examination Paper for each year will be divided into two sections, Silk Weaving, and Ribbon and Smallware Weaving, and will include questions founded upon the subjects of the following Syllabus.

Before entering upon the first year's course of instruction in the Technology of the subject, Candidates are recommended to attend a preliminary course of instruction in arithmetic, drawing, and elementary physics.

**I. Syllabus.**—The examination will include questions founded on the following subjects:—

### GRADE I.

1. The construction of various kinds of hand looms, including the single hand loom and its modifications, in developing into the power loom now in use.
2. Consideration of principal parts of power looms in so far as they are common to all, and modifications required to adapt them to weaving silk in plain, figured, and pile or cut fabrics.

3. The various counts of Jacquard machines, the satin jack, and other methods of lifting harness used in the ribbon industry.

4. Various descriptions of "monture" or harness used with Jacquard machines in silk weaving.

5. Construction and qualities of various shedding motions, the various methods of obtaining the shed in ribbon looms, and the proper relation in time between the shed movement, the shuttle, and the beat-up.

6. The various counts of cotton and spun silk, and the various sizes of silks.

7. The "picking" mechanism of power looms; the methods of moving the shuttle in ribbon looms.

8. Winding, warping, beaming, "drawing in" or "entering" and machinery connected therewith.

9. The principles of pattern designing and putting on ruled paper for Jacquard looms.

10. Counts of sleys or reeds, and how defined in various localities and weaving districts. Essentials of construction to be specially suitable for silk manufacture.

11. The construction of various fabrics, both single and double faced, as satins, ottomans, reps, terrys, twills.

12. Analysis of woven fabrics to determine the count, tie, or draft, and other details of their production.

The Examination in Grade I will be held on **Saturday, May 4th**, from 2.30 to 8 p.m., including a half-hour's interval for rest. Candidates should give three-and-a-half hours to the answering of the questions, and an hour-and-a-half to the analysis of fabrics. The fee for the Examination is *One Shilling and Sixpence*.

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#### FINAL EXAMINATION.

*Candidates for the Final Examination must hold a Certificate in Grade I.*

The Examination will be Written and Practical.

(1) **Written Examination.** More difficult questions will be set in the above questions and, in addition, a knowledge will be required of:—

1. Nature and quality of the various European and Asiatic silks, their distinctive properties, and the selection of the most suitable to employ in the manufacture of various articles.

2. The amount of spin and throw calculated to give the best results in various fabrics.

3. Counts of yarns ; cotton and spun silk, drams and deniers of silk, and basis of calculation by which necessary amount of materials could be determined for making certain fabrics.

4. Various kinds of charging or weighting silks in dyeing.

5. Manufacture of various kinds of silk fabrics, as gros-grains, satins, reps, (both single and double faced), crapes, ribbons, figured silks.

6. The perfection of cloth by using the best proportions of warp and weft.

7. Suitability of certain designs to make a sound fabric in the article intended to be produced.

8. The requisite calculations to arrive at the cost of a given fabric.

9. Simple principles of harmony and contrast of colour.

10. Finishing of woven fabrics after leaving the loom.

11. Analysis of fabrics to determine the details of their construction and the material used.

(2) **Practical Work.**—Each Candidate will be required during the year preceding the Examination to design and execute an original design of not less than 200 ends and 200 picks in each pattern or comber and also a pattern of a plain fabric, and to forward the same (carriage paid) to London, on or before April 29th, together with a certificate signed by his employer or by the class teacher and a member of the school committee stating that the design has been produced by the Candidate, and the work has been executed by him without assistance. The specimens of weaving must be not less than one yard in length and at least 21 inches wide.

In the case of ribbon patterns the dimensions should be one yard of a plain ribbon at least 44 lignes wide, and one yard of a figure pattern 40 lignes wide, with calculation of the cost of production.

In the case of small wares, the Candidate should submit one yard of plain small ware and one yard of fancy small ware of any width, with calculation of the cost of production.

The samples in all cases must be properly dyed and finished in all respects as practical trade samples.

The Final Written Examination will be held on Saturday, May 4th, from 2.30 to 8 p.m., under the same conditions as the Examination in Grade I. The fee for the Examination is *Two Shillings and Sixpence*.

**II. Full Technological Certificate.**—For the Full Technological Certificate, the Candidate will be required to qualify as stated in Rules 29 and 30, but Certificates showing that he has passed the Examinations of the Board of Education in Geometrical Drawing, as well as in Freehand or Model Drawing, will be accepted in lieu of one of the Science Certificates.

**III. Works of Reference.**—Dr. Lardner's Encyclopædia, article "Silk"; Journal of Silk Supply Association; "British Manufacturing Industries" (Stanford); Barlow's "History and Principles of Weaving" (Sampson Low, London); Taylor's "Cotton Weaving and Designing" (Longmans, 1893); "Ribbon Weaving," by J. Seillon (St. Etienne). "Silk Printing and Finishing," by G. H. Hurst. For other works on weaving, see Syllabus of Subject 26.

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### 33.—JUTE SPINNING.

**I. Syllabus.**—The course of instruction is intended to cover two years. Each year's work is indicated in the following syllabuses, which form a progressive course of study, and also define the subjects upon which the Examination questions will be founded. Candidates before presenting themselves for the Examination in Grade I are recommended to attend a preliminary course of instruction in Arithmetic, Drawing, and Elementary Physics.

#### GRADE I.

1. Nature and properties of jute, its cultivation, harvesting, setting, bailing, and preparation for the markets.

2. Mechanical rules for the calculation of speeds of gearing pulleys, &c.

3. Batching. General knowledge of the operations of softening and batching, including descriptions of the machines generally in use.

4. Carding. Various kinds of carding engines, the objects to be attained by carding. The functions of the various organs of the carding engine, and their relation to each other. Method of regulating weight of sliver, and calculation of draft.

5. Drawing frames. Objects to be attained by drawing and doubling, calculation of draft, description of the mechanism of the various gills in ordinary use.

6. Roving frame. Description of machine, calculation of draft and twist, general understanding of the uptake motion and its use.

7. Spinning frame. Its mechanism, calculations relating to draft, twist and speed of rollers and spindles, doubling and twisting frames.

8. Reeling and winding. Yarn tables and length of reel, methods of reeling and making up yarns, warp and weft winding machines.

### FINAL EXAMINATION.

*Candidates for the Final Examination must hold a certificate in Grade I.*

In the Final Examination more difficult questions will be set in the above subjects, and in addition questions will be founded on :—

1. The various methods of batching, the oils in use and their application and effect on the quality and nature of the yarn produced.

2. The selection of various kinds and marks of jute for different qualities and makes of yarn.

3. The principles of carding, construction and specification of card clothing, adjustment, and relative speed of the various organs of the carding engine.

4. The principles of drawing and doubling, with arrangements of machines to produce the best results. Complete description and specifications of the gills in common use.

5. Production of rove, details and theory of uptake motion, and trim of machine to produce good rove.

6. Suitable reach, draft and trim of spinning frame for different yarns. The twist of yarns for various purposes, and theory of twist.

7. Machinery for the production of doubled yarn and jute twines.

8. Horse-power required for various machines, and experimental methods of determining it.

9. Construction and planning of jute mills, with arrangement of machinery for economical production. The production of the various machines in a system. Methods of lighting, heating, ventilating, and fire protection.

10. Cost of production, wages and labour charges, insurance, and other charges.

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The Examination in both Grades will be held on **Monday, April 29th, 7 to 10 p.m.** The fee for the Examination in either Grade is *One Shilling and Sixpence.*

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**II. Full Technological Certificate.**—For the Full Technological Certificate, the Candidate must qualify as stated in Rules 29 and 30, but Certificates showing that he has passed the Examinations of the Board of Education in Geometrical Drawing, as well as in Freehand or Model Drawing, will be accepted in lieu of one of the Science Certificates.

**III. Works of Reference.**—"Report on the Cultivation of Trade Jute in Bengal," by Hem Chunder Ker, 1874 (printed at the Bengal Secretariat Press); "The Fibrous Plants of India," by Dr. Forbes Boyle; "Flax, Tow, and Jute Spinning," by Peter Sharpe (J. P. Mathew & Co., Dundee); "Jute Spinning," by Wm. Leggatt (Wm. Kidd, Dundee); "The Disc and Differential Motions," by Hovell.

### 34.—JUTE WEAVING.

**I. Syllabus.**—The course of instruction is intended to cover three years. Each year's work is indicated in the following syllabuses, which form a continuous and progressive course of study, and also define the subjects upon which the Examination questions will be founded. Candidates before presenting themselves for the Examination in Grade I are recommended to attend a preliminary course of instruction in Arithmetic, Drawing, and Elementary Physics.

Candidates, by permission of their teachers, may enter in the same year for the Examinations in both Grade I and Grade II.

#### GRADE I.

1. Jute yarns. System of counting with calculations. The form in which yarns are supplied to the manufacturer, as hanks, cheeses, bobbins, cops, &c.
2. Warp and weft winding machinery. Cops and pirns, the advantages and disadvantages of each system.
3. The preparation of warp yarns. Chain warping, with bank setting for self-coloured or striped warps, and calculations thereon.
4. Dressing machines, their construction and driving, starch or size ingredients and manufacture, brushing, drying, reeding, measuring and marking, with calculations relating thereto.
5. The relative advantages of warps made on the dressing machine and warping mill, and of dry and starched warps.
6. Beaming. Method of drawing the warps through the cambs, with calculations for casting out, &c.
7. The hand loom. Treadle and dobby shedding.
8. Power loom construction and mechanism.—The drawing of tappets or cambs, the effect of variation of dwell and change on the

yarn and cloth, positive and negative uptake motions, and general arrangement of parts.

9. Design paper. The method of indicating the movements of each camb.

10. Weaves employed, and the dissection of patterns for the simpler fabrics made from jute, to determine draft for the cambs and weaving plan.

11. Calculations for obtaining the weights of warp and weft for the above fabrics.

12. Application of coloured threads in the warp.

The Examination in Grade I will be held on Thursday, May 2nd, from 7 to 10 p.m. The fee for the Examination is *One Shilling*.

No Certificates will be granted on the results of the above Examination, but the Candidates' successes will be notified to the centres at which they were examined.

## GRADE II.

*Certificates will be issued to those Candidates only who have passed the Examination in Grade I in the same or a previous year.*

1. Power looms, various kinds of dobbies. The methods of actuating shedding, picking, box, set off and uptake motions.

2. The Jacquard machine, single and double lift, double cylinder, cross border machines. Methods of tying up, casting out, &c., card cutting and lacing.

3. Combination of weaves for producing stripes and checks, close and open effects for embroidery cloth, &c., with drafting and weaving plans.

4. The necessary instructions to winders, warpers, beamers, &c., for producing a given quantity of cloth.

5. Suitability of jute yarns to combine with wool, worsted, silk, linen, &c.

6. The method of employing coloured yarns in warp and weft to produce stripes and checks.

7. Analysis of cloths produced on ordinary Jacquards and dobbies, giving weave, tie up or draft, counts of warp and weft, order of warping and wefting, reed, pick, weight and number of repeats necessary for production in any width.

No questions will be asked in this course relating to any of the preparatory machinery or processes, except in so far as they affect the general cost of production or waste made in the preparation of the yarns for the loom.

The Examination in Grade II will be held on Saturday, May 4th, from 2.30 to 6.30. The fee for the Examination is *One Shilling and Sixpence*.

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## FINAL EXAMINATION.

*Candidates for the Final Examination must hold a Certificate in Grade II.*

Candidates will be required to show a knowledge of the preparatory processes, machinery, appliances, and principles of designing introduced into the two preceding courses, and also of the analysis and synthesis of two or more ply textures of tapestry and pile fabrics, figured by the Jacquard. The Examination will include a paper on general questions, and papers on Sections A and B, the former relating specially to Designing and Colouring, the latter to Mill Management. To obtain a Certificate Candidates will be required to pass in the General Paper and in Section A or B.

*General Syllabus for either Section.*

1. The nature and properties of the different fibres used for manufacturing processes, and the method of distinguishing one from another.

2. Items to be considered before selecting the reed, picks, counts, and weave of any cloth for given purposes.

3. The selection of warp and weft yarns adapted to the various types of pile and other fabrics, such as Axminster, Brussels, and Scotch carpets and tapestries.

4. The structure and analysis of compound fabrics, such as backed, double and several ply, and the various types of Jacquard figured fabrics specially applicable to the Jute branch of textile industry.

5. The principles of designing, cloth structure, and colouring best adapted to the above-named fabrics; also of cloth formed by Jacquard pile and ordinary weaves.

6. Method of designing and colouring reversible double cloths and tapestries.

7. Latent and other defects in fabrics caused by faulty preparation of warp, or faulty construction and unequal balancing of warp and weft. Calculations relating to cloth structure.

8. The shedding mechanism particularly adapted to each of the above-named fabrics, such as special construction of Jacquard machines, hooks and mails combination mountings; construction of Jacquard lifting cams; the arrangement of mechanism for controlling them, and also for controlling healds and comber boards.

9. Calculations involved in determining the departmental and total cost of production of any fabric from given data of values of



materials, labour, and standing charges, by ascertaining the fibre, counts, ends, picks, and weight.

The Examination in the General section will be held on Wednesday, May 1st, from 7 to 10.

### *Section A.*

The Examination will be Written and Practical.

(1) **Written Examination.**—The Written Examination will include questions on the following subjects :—

1. Designing for the Jacquard machine. The distribution of figures in various ways to produce different effects. Method of transferring sketches of patterns to design paper, and the reason for various rulings of such paper.

2. Fancy diagonal or figure effects obtained by introducing upon a jute ground some other material as an extra warp, an extra weft, or both.

3. The transfer of plain sketches on to point paper, with the necessary data required for the production of the design on the loom.

4. The nature of weave, weight, and purpose of fabrics, to which conventional and natural ornament may with advantage be applied, and in which geometric motives may form a prominent part.

*Drawing paper is supplied by the Institute, but all instruments, pencils, colours, or other materials required must be provided by the Candidates or the School.*

(2) **Practical Work.**—Each Candidate for Section A will be required to forward to London, by April 29th, at latest, two original designs occupying not less than 192 threads and 96 picks. It is only necessary to produce the woven sample for one design.

Each Candidate's work must be accompanied by a certificate signed by his employer, or by the class teacher and a member of the school committee, stating that the design has been produced by the Candidate and the work has been executed by him without assistance.

Forms of certificate, and printed forms with instructions, on which particulars of woven samples must be written, may be had on application.

The Examination in Section A will be held on Saturday, May 4th, from 2.30 to 6.30. The fee for the Examination is *Two Shillings and Sixpence*.

## Section B.

Candidates in Section B may be required to answer questions on the following subjects :—

1. The particular advantages of different systems of preparing warps, and their suitability for either grey jute, coloured jute, or mixed fabrics.

2. The selection of preparatory and weaving machinery for manufacturing any class of fabrics in which jute largely predominates, and the relative capacity of machines for specific purposes.

3. The structure of two or more ply weaves as far as they are applicable to jute fabrics.

4. The most desirable situation of weaving factories as regards wind, climate, proximity to market towns, water and coal.

5. Factory buildings, arrangements of machinery with regard to economical working and oversight, natural and artificial lighting, ventilation, heating, insurance of buildings, plant and stock.

6. The transmission of motive power, speed of shafting, and most suitable speeds for the various machines.

7. The finishing and packing of Jute goods.

The Examination in Section B will be held on Thursday, May 2nd, from 7 to 10 p.m. The fee for the Examination is *Two Shillings and Sixpence*. For Examination in both Sections A and B, the fee is *Four Shillings*.

**II. Full Technological Certificate.**—For the Full Technological Certificate, the Candidate must have passed the Examinations in all three Grades, and must qualify as stated in Rules 29 and 30, but Certificates showing that he has passed the Examinations of the Board of Education in Geometrical Drawing, as well as in Freehand or Model Drawing, will be accepted in lieu of *one* of the Science Certificates.

**III. Works of Reference.**—For works on Weaving see Syllabus of Woollen and Worsted Weaving, Subject 26; “Weaving and Design of Textile Fabrics,” by Ashenhurst (Bradford); “The Construction of the Power Loom,” and “The Art of Weaving,” by Alexander Brown (Mathew & Co., Dundee); “Art of Weaving,” by Wm. Leggatt (Wm. Kidd, Dundee); “Jute and Linen Weaving,” by Messrs. Woodhouse and Milne (Emmot & Co., London & Manchester, 1904), Part I “Mechanism,” Part II “Calculations.” Also original papers in “The Textile Manufacturer.”

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*For Syllabus of Examinations in “The Principles of Art as applied to the Design of Patterns for Weaving,” see page 288.*

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## 35.—LACE MANUFACTURE.

I. Syllabus.—The Examination will include questions founded on such subjects as the following :—

## GRADE I.

1. A general knowledge and description of the article to which the term lace is ordinarily applied, whether real lace or imitations thereof made by machinery.

2. The difference between the weaving loom and the lace-machine.

3. The methods used in making real lace. Materials generally used and places most renowned for its production.

4. Description of the different machines now most in use for making imitation lace, both plain and ornamental, and the lace made on them. The places where the manufacture of machine-made lace is principally carried on.

5. Other machines applied to the lace-machine proper, for producing ornamental designs on the fabric. Their construction, special objects, and methods of working in connection with the lace-machine.

6. Various methods of making lace with single and double warps. The movements of the various threads. The kinds of silk, cotton, or other material most suited for special and ordinary purposes. The usual systems of arranging the sleys and materials for producing certain designs to be given on various lace foundations.

7. The system of calculating the remuneration due to the workman; the quality and amount of material required to make a warp for any particular kind of lace described.

8. The different systems of calculating the various lengths of threads in one pound of any given number, whether of silk, cotton, linen, or wool.

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FINAL EXAMINATION.

In the Final Examination, questions of a more difficult character will be set, and in addition the Candidate will be required to give a design and draft of one of the laces described in his paper.

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The Examination in both Grades will be held on Tuesday, April 30th, 7 to 10 p.m. The fee for the Examination in either Grade is *One Shilling*.

II. Full Technological Certificate.—For the Full Technological Certificate, the Candidate will be required to qualify as stated in Rules 29 and 30, but Certificates showing that he has passed the Examinations of the Board of Education in Geometrical Drawing, as well as in Freehand or Model Drawing, will be accepted in lieu of one of the Science Certificates.

III. Works of Reference.—“Lace and Embroidery,” by Mrs. Bury Palliser; “A History of Lace,” by Mrs. Bury Palliser; “Lace and Hosiery Manufactures,” by Felkin; “Old Lace: its History, Characteristics and Manufacture” by Jourdain (Batsford, 1908).

### 36.—FRAMEWORK KNITTING AND HOSIERY.

I. Syllabus.—The Examination will include questions founded on such subjects as the following:—

#### GRADE I.

1. *Fibres*.—Fibres used for textile fabrics—their structure, characteristic features, and adaptation for different knitted Fabrics.

2. *Textile Fabrics*.—Origin of textile fabrics. Their structure. Knitting as the most suitable for hosiery, and why.

3. *Knitting*.—The framework knitted loop and its formation by hand and machine.

4. *Framework Knitting*.—The hand stocking frame. Its study as a key to the principles of framework knitting.

5. *Frame Gauges*.—The construction of frames as regards gauges, and how they are calculated, with comparisons of the various principles.

6. *Numbering of Yarns*.—Yarns and their numbers. How they are calculated, and their comparison with frame gauges.

7. *Rib Knitting*.—Rib frames. The rib machine.

8. *Warp Fabrics*.—The warp knitting stitch and the hand warp loom.

9. *Circular Machinery*.—The study of plain and rib circular frames. The needles used. The construction and mode of working the various machines. The English loop-wheel circular frames. The French or German circular frames. The English latch-needle circular frames. The American latch-needle knitting machines.

10. *The Lamb Frame*.—The study of the hand, flat, or Lamb knitting machines.

11. *Rotary Frames*.—The principles and construction and mode of working the jack and sinker rotary frames.

12. *Circular Knitting Machines*.—The circular hand knitting machine, its construction and mode of working. Its distinction from latch-needle circular frames.

13. *Winding*.—Preparation of yarn and winding of the same. Principle of winding machines.

14. *Imperfect Knitting*.—Imperfections in a knitted fabric. Their cause and remedy.

15. *Fancy Framework Knitted Fabrics*.—The technicalities and construction of knitted fabrics as made on the hand-frame and plain and rib circular frames described:—(a) Stripe work (horizontal). (b) Stripe work (vertical). (c) Patterns—Squares, checks, plaids, &c. (d) Tuck work. (e) Press-off work. (f) Top machine work. (g) Pelerine work. (h) Rib fabric, including polka rib, royal rib, shogged rib, tuck rib, &c.

16. *Hosiery Manufacturing*.—The principles of the manufacture and putting together of—(a) Half-hose, hose, socks, and similar goods. (b) Shirts, vests, &c. (c) Pants, trousers, &c. (d) Combination garments. (e) Sweaters, jerseys, cardigans, &c.

17. *Hosiery Finishing*.—(a) First principles of dyeing, trimming, finishing and ornamenting for sale purposes. (b) Mending. (c) Making up of articles cut from fabric.

#### FINAL EXAMINATION.

1. *Rotary Frames*.—Jack and sinker plain rotaries. Cotton's patent plain rotaries. Mellor, Blackburn, and Cotton rib rotaries.

2. *Designing on Rotary Frames*.—Tuck and press-off. Lace work. Bottom machine work, &c. Horizontal and vertical, stripes and fancy designs. Plaiting. Warp and weft knitting.

3. *Sewing and Seaming*.—Sewing machine stitches. Machines used. Application of stitches. American and overlock machines and all the stitches they make, and for what purpose they are applied in the trade.

4. *Designing on Circular Frames*.—On English, French, and German circular frames, by—(a) Tucking. (b) Press-off work. (c) Plaiting. (d) Lace work, &c. Ditto on latch-needle machines.

5. *Flat Knitting Machines*.—Construction of the principal machines used.

A study of cams and their action. Designing on flat knitting machines as used for sweaters, jackets, and sporting hose of all kinds. (a) By tucking, &c. (b) By jacquard. (c) By pearl work. (d) Principles of designing. (e) Working out of designs.

6. *Spinning*.—The various yarns used in the hosiery trade and their method of spinning.

7. *Trimming and Finishing of Hosiery*. Processes through which hosiery passes in the trimming department, with their action and results.

8. *Costing*.—Principles of costing fabrics, and the adding on of profits.

9. *Winding Machines*.—Construction of winding machines used in the trade.

10. *Warp Machines*.—(a) The flat loom. (b) The fast loom. (c) The Milanese loom. (d) The rib loom—single rib and double rib. (e) The steel bar loom. (f) Circular loom.

11. *Designing on Warp Machines*.—(a) On one-bar machines. (b) On two-bar machines. (c) Other principles of fancy work, &c. (d) Designing and working out of designs.

12. *Automatic Knitting Machines*.—*Plain*.—The principles of plain circular automatic knitting machines. (a) The depressing principle. (b) The picker principle. (c) The moving cam principle. (d) Various other principles.

Study of various automatic machines, the changes to be made, the principles of ten or twelve different machines.

13. *Automatic Knitting Machines*.—*Rib*.—(a) The rib machine. (b) The automatic rib machine. (c) The stitch changing machine.

14. *Making of Gloves*.—(a) Cut Gloves. (b) Wrought gloves.

15. *Yarn Numbering*.—The comparative systems. Resultant and average counts. Relative and cost weight of mixed yarns. Practical exercises.

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The Examination in both Grades will be held on **Tuesday, April 30th, 7 to 10 p.m.** The fee for the Examination in either Grade is *One Shilling*.

II. *Full Technological Certificate*.—For the Full Technological Certificate, the Candidate will be required to qualify as stated in Rules 29 and 30, but Certificates showing that he has passed the Examinations of the Board of Education in Geometrical Drawing, as well as in Freehand or Model Drawing, will be accepted in lieu of one of the Science Certificates.

III. *Works of Reference*.—Rowlett's "Technology of Framework Knitting," translated from the German of Gustav Willkomm (published by the Leicester Technical School); "A Textbook of Hosiery," by William Davis (Kennedy, Hawick, 1908); "Framework Knitting and Hosiery Manufacture" by Quilter and Chamberlain (Hosiery Trade Journal Offices, Leicester); "The Trimming and Finishing of Hosiery and Hosiery Fabrics," by J. H. Quilter (Bradford); "Comparative Yarn Tables," by McLennan Blair & Co., Yarn Merchants, Glasgow (published by compilers); "Counts and Gauges," by J. H. Quilter (The Technical Bureau, 11, Millstone Lane, Leicester); "The Knitters' Circular and Monthly Record" (Leicester).

### 37.—TELEGRAPHY AND TELEPHONY.

Separate Examinations will be held in A.—Telegraphy ; B.—Telephony.

*Candidates who hold First Class Certificates in the Ordinary Grade of Telegraphy and Telephony, issued on the results of the joint examination formerly held, may only present themselves for the Final Examination in Telegraphy or Telephony.*

#### A.—TELEGRAPHY.

I. Syllabus—The examination will include questions founded on such subjects as the following :—

##### GRADE I.

1. *Preliminary.*—The fundamental principles of electricity and magnetism in their application to Telegraphy ; units of measurement ; standards of electromotive force, resistance and capacity. Essential qualities of iron and steel for permanent and electro-magnets, methods of making permanent magnets, simple calculations relating to electro-magnets.

2. *Batteries.*—Primary and secondary, as used in telegraphy ; construction and chemical action ; grouping of primary batteries, calculations of the number of cells and battery power required to work circuits ; the advantages of secondary batteries. The simpler methods of measuring electromotive force and resistance.

3. *Telegraph Instruments.*—The principles and construction of Wheatstone's A B C, single needle, sounder (ordinary and polarised), keys, relays, and simple switches.

Galvanometers : The principles and construction of the following types—Astatic, differential, tangent, Thomson, and suspended coil.

Shunts and their use.

Resistance Coils : Construction of, gauge and kind of wire for, methods of winding and insulating, effect of temperature variation.

Condensers : Construction and testing of ; their uses in the simpler telegraph systems.

Inspection and testing of telegraph instruments.

4. *Telegraph Lines.*—Aerial, underground, and submarine : construction of, and relative advantages of each class.

Testing instruments employed and methods of using them in the simpler tests ; apparatus employed by linemen.

Faults in : their nature ; general principles of localisation.

5. *Telegraph Systems*.—The simpler systems of manual telegraphy, including single and double current duplex, common battery systems and universal working; also simple methods of cable telegraphy.

6. *Miscellaneous*.—Earth currents, nature of, and methods of preventing disturbance therefrom.

Methods of protecting lines and apparatus from (a) Lightning, (b) Power circuit currents.

Suitable illustrative diagrams should be systematically introduced into answers.

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### FINAL EXAMINATION.

*Candidates for the Final Examination must hold a Certificate in Grade I.*

In addition to more difficult questions on the subjects of Grade I, questions will be set in the subjects enumerated below:—

1. *Preliminary*.—Units, absolute and practical; relations of electro-static and electro-magnetic units.

2. *Secondary Cells*.—Chemistry of, care of, method of charging, capacity and efficiency of, testing, method of equalising output and distribution of current, switching and protective arrangements.

3. *Construction*.—Testing of materials employed.

Aerial lines; factor of safety; stresses on poles; static and kinetic stresses on wires; law connecting sag and stress; regulation of wires.

Underground lines; modern practice.

Submarine lines; manufacture, laying, and repairing.

Internal wiring of large telegraph offices.

4. *Telegraph Instruments*.—Wheatstone apparatus, Hughes, Baudot, the siphon recorder, the undulator and cable relays; general principles of construction.

5. *Telegraph Systems*.—Wheatstone, quadruplex, type-printing telegraphs; concentration, inter-communication and common battery systems; methods of working long submarine cables; superimposed circuits; simultaneous telegraphy and telephony.

6. *Repeaters*.—Principles of, simplex and duplex; forked and divided quadruplex.

7. *Telegraphic Transmission*.—The effects of capacity and inductance in circuits; methods of reducing, compensating for, and eliminating the same; laws governing the speed of working on long aerial, underground, and submarine lines.



8. *Testing*.—Apparatus : Wheatstone bridge ; tangent, ballistic and reflecting galvanometers ; ammeters ; voltmeters : theory, construction and methods of use. Localisation of earths, contacts, and disconnections on line wires ; capacity, resistance, inductance, and insulation measurement ; measurement of resistance and E.M.F. of batteries ; Post Office Morning Test system.

9. *Wireless (or Radio-) Telegraphy*.—Theory of ; principal systems in use ; construction of aerial gear ; transmitting and receiving apparatus ; wave measuring devices.

10. *Miscellaneous*.—Variable period of a current ; Helmholtz's equations ; Kirchhoff's and Maxwell's laws ; electro-magnet coils, simple formulæ for.

Suitable illustrative diagrams should be systematically introduced into answers.

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The Examination in Grade I will be held on **Monday, April 29th**, and the Final Examination on **Thursday, May 2nd**, from 7 to 10 p.m. The fee for the Examination in Grade I is *One Shilling and Sixpence*, and for the Final Examination *Two Shillings and Sixpence*.

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**II. Full Technological Certificate.**—For the Full Technological Certificate the Candidate will be required to qualify as stated in Rules 29 and 30.

**III. Works of Reference.**—"Elementary Lessons in Electricity and Magnetism," by Professor S. P. Thompson (Macmillan 4s. 6d.) ; "Magnetism and Electricity for Students," by H. E. Hadley (Macmillan, 6s.) ; "Higher Text Book of Magnetism and Electricity," by R. W. Stewart (University Tutorial Press, Ltd., 6s. 6d.) ; "Management of Accumulators," by Sir D. Salomons (Whittaker) ; "Secondary Cell Installations," by A. Crotch (Pitman, 2s. 6d. net.) ; "Electric and Magnetic Circuits," by E. H. Crapper (Arnold) ; "Electrical Engineering," by Slingo and Brooker (Longmans) ; "Magnets and Electric Currents," by Dr. J. A. Fleming (E. and F. N. Spon, 7s. 6d.) ; "Practical Electricity," by Professor W. E. Ayrton (Cassell, 7s. 6d.) ; "Telegraphy," by T. E. Herbert (Whittaker) ; "Telegraphy," by Preece and Sivewright (Longmans, 7s. 6d.) ; "Handbook of Electrical Testing," by H. R. Kempe (E. and F. N. Spon, 18s.) ; "Signalling Across Space Without Wires," by Lodge (Electrician Publishing Company, 5s. net.) ; "Connections of Telegraphic and Telephonic Apparatus, General Post Office" (Eyre and Spottiswoode, 1s. 3d.) ; "Telegraphic Systems" by A. Crotch (Griffin) ; "Telegraph Switching Systems," by T. F. Purves (Alabaster, Gatehouse and Company, 2s.) ; "Student's Guide to Submarine Cable Testing," by Fisher and Derby (The Electrician Publishing Company) ; "Electrical Testing for Telegraph Engineers," by J. E. Young (The Electrician

Publishing Company); "The Principles of Electric Wave Telegraphy," by J. A. Fleming (Longmans); "An Elementary Manual of Radio-Telegraphy and Radio-Telephony," by J. A. Fleming (Longmans, 7s. 6d.); "Submarine Cables, Laying and Repairing," by H. D. Wilkinson (The Electrician Publishing Company); "Maxwell's Theory and Wireless Telegraphy," by Poincaré and Vreeland (Constable and Company, 10s. 6d. net.).

## B.—TELEPHONY.

I. Syllabus.—The Examination will include questions founded on such subjects as the following:—

### GRADE I.

1. *Preliminary.*—The fundamental principles of Electricity and Magnetism in their application to Telephony; units of measurement; standards of electromotive force, resistance, inductance, and capacity. Essential qualities of iron and steel for permanent and electro-magnets; methods of making permanent magnets; simple calculations relating relating to electro-magnets. The theory of the electric transmission of sound.

2. *Batteries.*—Primary and secondary batteries as used in telephony; application of secondary batteries to common battery and trunk working.

3. *Telephone Instruments.*—The various transmitters and receivers in common use: transformers, keys, impedance coils, repeating coils, magneto and other call bells, magneto generators, indicators, jacks, relays, condensers, and other minor apparatus: construction and principles of.

4. *Telephone Lines.*—Aerial and underground, construction of; electrostatic and electromagnetic disturbances, methods of eliminating; advantages of metallic circuits; testing of, instruments employed and methods of using them in the simpler tests; apparatus employed by linemen; faults, their nature; general principles of localisation.

5. *Telephone Systems.*—The simpler systems of telephony, including the principles of common battery and trunk working; the simpler types of standard switchboards; magneto and central energy.

6. *Protective Devices.*—Methods of protecting lines and apparatus from (a) Lightning, (b) Power circuit currents.

Suitable illustrative diagrams should be systematically introduced into answers.

## FINAL EXAMINATION.

*Candidates for the Final Examination must hold a Certificate in Grade I.*

In addition to more difficult questions in the subjects of Grade I, questions will be set in the subjects enumerated below :—

1. *Preliminary*.—Units, absolute and practical ; relations of electrostatic and electromagnetic.

2. *Secondary Cells*.—Chemistry of, care of, method of charging, capacity and efficiency of ; testing, switching and protective arrangements.

3. *Construction*.—Testing of materials employed ; aerial lines ; modern practice ; stresses on poles ; static and kinetic stresses on wires, law connecting sag and stress, regulation of wires ; factors of safety.

Underground and submarine lines ; modern practice.

4. *Telephone Apparatus*.—Construction and theory of telephonic apparatus generally, methods of use and maintenance, various forms of transmitters and receivers, tests for efficiency, subscribers' sets.

5. *Telephone Systems*.—Manual Exchanges: magneto and common battery, complete multiple, partial multiple, divided multiple, transfer, method of ringing, engaged tests. Lay-out of Exchanges : equipment, including frames, racks, sections, desks, apparatus and power plant. Automatic Exchanges, general principles of. Party-line Systems : circuits exchange equipment, subscribers' station equipment. Private branch exchanges, "house" systems, pay stations coin-collecting boxes. Junction circuits : methods of working between local exchanges in the same area and between trunk and local exchanges. Trunk circuits : Exchange equipment, circuits, methods of working, signalling, recording calls. Superimposed or multiplex circuits. Simultaneous telegraphy and telephony on the same wires, practical systems and theory of.

6. *Telephonic Transmission*.—Limiting factors ; attenuation and distortion ; loading ; Pupin's and other formulæ ; effects of leakage ; conductance ; comparative efficiencies of wires of various materials and gauges, open, underground and submarine.

7. *Testing*.—Apparatus : Wheatstone bridge ; tangent, ballistic and reflecting galvanometers ; ammeters ; voltmeters :—theory, construction, and methods of use ; localisation of earths, contacts, and disconnections on line wires ; capacity, resistance, inductance and insulation measurements ; measurement of resistance and E.M.F. of batteries : Post Office Morning Test system (for long distance lines).

8. *Miscellaneous*.—Kirchoff's and Maxwell's laws; electromagnet coils, simple formulæ for; telephone repeaters.

Suitable illustrative diagrams should be systematically introduced into answers.

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The Examination in Grade I will be held on Wednesday, May 1st, and the Final Examination on Thursday, May 2nd, from 7 to 10 p.m. The fee for the Examination in Grade I is *One Shilling and Sixpence*, and for the Final Examination *Two Shillings and Sixpence*.

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II. Full Technological Certificate.—For the Full Technological Certificate the Candidate will be required to qualify as stated in Rules 29 and 30.

III. Works of Reference.—“Elementary Lessons in Electricity and Magnetism,” by Professor S. P. Thompson (Macmillan 4s. 6d.); “Magnetism and Electricity for Students,” by H. E. Hadley (Macmillan 6s.); “Higher Text Book of Electricity and Magnetism,” by R. W. Stewart (University Tutorial Press, Ltd., 6s. 6d.); “Management of Accumulators,” by Sir D. Salomons (Whittaker); “Secondary Cell Installations,” by A. Crotch (Pitman 2s. 6d. net); “Electric and Magnetic Circuits,” by E. H. Crapper (Arnold); “Electric Engineering,” by Slingo and Brooker (Longmans); “Magnets and Electric Currents,” by Dr. J. A. Fleming (E. and F. N. Spon, 7s. 6d.); “Practical Electricity,” by Professor W. E. Ayrton (Cassell 7s. 6d.); “Practical Telephone Handbook,” by J. Poole (Whittaker); “American Telephone Practice,” by Kempster B. Miller (McGraw Publishing Company); “Connections of Telegraphic and Telephonic Apparatus, General Post Office” (Eyre and Spottiswoode 1s. 3d.); and the current technical literature.

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### 38.—ELECTRIC WIREMEN'S WORK.

The Examinations in Wiremen's Work will be held in two Grades. The Examination in Grade I will be adapted to the requirements of journeymen and the Final Examination to the requirements of those who may be engaged as foremen. First and Second Class Certificates will be granted on the result of each Examination. Both the Examination in Grade I and the Final Examination will be in part Written and in part Practical, and the Written Examination and the Practical Test must be taken in the same year.

Candidates for either Examination will be required to produce evidence of having satisfactorily attended during the session preceding examination, in a Class registered by the Institute, a course

of lecture, workshop and laboratory instruction in the subjects of examination. The Institute will accept a Certificate from the Instructor of the Class, countersigned by the Principal or Secretary of the School, as evidence of such attendance. Applications from Candidates for some relaxation of this condition, by reason of their being actually engaged in practical work will be separately considered. Such an application must be made to the Department at least a fortnight before application for examination is made to the Local Secretary.

### GRADE I.

**Syllabus.—(1) Written Examination.**—The Written Examination will include questions in the following subjects:—

1. *Electricity.*—The Elementary Principles of Electricity and Magnetism so far as necessary for understanding the matters referred to in the following paragraphs.

2. *Conductors.*—The standard wire gauge; recognition at sight of the different sizes of stranded copper wire in common use.

3. *Resistance Wires.*—Properties of resistance materials in common use; methods of winding and connecting resistance spirals and the installation of resistances.

4. *Fuse Wires.*—Properties of materials in common use. Precautions in installing.

5. *Jointing.*—Construction and use of the blow lamp and soldering iron. Making of married and tee joints on conductors up to 19/16 size or its equivalent. Sweating of joints, thimbles, and connectors without burning the metal or leaving the joints rough.

6. *Insulators.*—Porcelain, pure and vulcanised rubber, paper, slate, marble, fibre, &c. Insulation of single and twin wires on rubber and paper cables up to  $\frac{1}{2}$  square inch size, or its equivalent.

7. *Wiring Systems.*—Cleats, insulators, wood casing, metal piping and conduits. Full details of handling material fixing in position, running of wires. Mechanical and electrical coupling of metal pipes on both screw and slip joint systems.

8. *Connections* to distribution boards, cut-outs, ceiling roses, lamp holders, switches, including two-way switches, fuses. Wiring of electroliers, brackets and other fittings, connecting up and finishing off connections for incandescent lamps, Nernst lamps, arc lamps, and motors.

9. *Testing*.—Use of the test lamp and detector for sorting out circuits. Pole finding.

10. *Bells*.—The installation of electric bells. Indicators.

11. General plan of a building, with especial reference to construction of floors.

(2) *Practical Examination*.—The Practical Examination will be such as to test the Candidates' knowledge of the following processes, and other operations performed by journeymen wiremen, and their ability to carry out any of the operations relating thereto :

Methods of handling wire and cable.

The soldering iron. Methods of tinning and heating fluxes. Sweating and preparing thimbles and lugs, making the following joints :—Running, end to end, T and Y in 1/18, 3/22, 7/16, 19/16. Connecting to ceiling roses, switches, plugs, holders, &c. Methods of connecting flexibles. Insulating joints. Looping in.

Cutting, screwing, and bending metal pipes and conduits.

#### FINAL EXAMINATION.

Candidates for the Final Certificate will be required to have passed the Examination in Grade I. They will also be required to have passed an approved examination in the principles of Magnetism and Electricity, and to produce evidence of satisfactory attendance, during the session preceding examination, in a class registered by the Institute at a course of instruction in the subjects of examination, including laboratory work.

The Examination for the Final Certificate will consist of two parts ; (1) a *Written Examination* in the Advanced Principles of Wiring including Drawing, Elementary Electrical Engineering and Electrical Calculations, (2) *Practical Wiring*.

The course of instruction with a view to the Final Examination should cover a period of at least two years.

(1) *Written Examination*.—The Written Examination will be divided into three sections, in each of which the Candidate will be required to satisfy the Examiners. The examination may include more difficult questions in the subjects of the Examination in Grade I, and Candidates will also be required to show a knowledge of the following subjects :—

##### 1. ELECTRICAL CALCULATIONS.

1. *Electrical Units*.—Electric units and their relations.

2. *Resistance*. — Calculation of "drop" in the more commonly used wires and cables for—

(a.) Various loads expressed in amperes or lamps.

(b.) Various lengths of run.

Drop when using "safe working currents"; increase of copper required to reduce drop; practical rules.

3. *Problems Relating to Power*.—Power required by motors, lamps and controlling resistances under various conditions; connection between electrical, mechanical, and thermal units of power and work; methods of transforming quantities of energy, however measured, into kilowatt-hours.

4. *Calculations* referring to cost of energy.

5. *Calculations* of contact areas for switches and cross-sectional areas for bus bars, cables, &c.

6. *Calculation* of resistances to be run in series with arc lamps on various circuits; current carrying capacity of resistance frames and coils; calculations in connection with the photometry of arc and incandescent lamps.

7. *Problems* dealing with the distribution of light in buildings.

## 2. ELEMENTARY ELECTRICAL ENGINEERING.

1. *Electrical Measurements*.—Applications of Ohm's law. Simple methods of measuring resistance, E.M.F. and current. Chief types of ammeters, voltmeters, wattmeters, and supply meters.

2. *Electrical Properties of Materials*.—Conductors and insulators. The effect of commonly occurring conditions, such as moisture, heat, &c. Conditions which hasten deterioration.

3. *Magnetic Properties of Materials*.—The magnetisation of iron by electric currents; permeability; the law of ampere turns; electro-magnets and simple applications of the principle of the magnetic circuit.

4. *Secondary Batteries*.—The various types; their installation and practical treatment. Precautions in charging and discharging. Testing state of cell by hydrometer and voltmeter.

5. *Electric Lighting*.—Carbon and metal filament lamps. Nernst lamps. Arc lamps. Current and voltages required by the more commonly used glow lamps. Methods of testing. Photometry and illumination.

6. *Electrical Machinery*.—C.C. and A.C. motors; general principles of action; the practical importance of the back E.M.F. and conditions of producing it; field windings and

their connections with the armature and the supply circuit ; the more commonly occurring causes of breakdowns and their remedies ; care of commutators. Starting switches ; no voltage and overload release devices ; principles involved. Field breaking switches.

C.C. and A.C. Dynamos : their installation and running ; regulation by resistance in field circuit ; principles involved. Testing of motors and dynamos for insulation ; temperature tests under load ; testing for faults.

### 3. ELECTRIC WIRING.

In addition to the subjects of Grade I, the following to be taken :—

The Wiring Rules of the Institution of Electrical Engineers. Consideration of the rules of the leading fire offices and of local supply authorities. Insulation testing with Ohmmeter and generator, or sets such as the Silvertown testing tests. Location and temporary repair of faults in installations. Details of different sizes of cables, switches, and cut-outs in general use and their safe carrying capacity. Rating of fuses. The connecting-up of motors and dynamos of various types. Methods of altering speed and direction of rotation.

The three-wire system and lamp and motor connections thereon.

The care and maintenance of secondary batteries. The trimming, cleaning, and maintenance of arc lamps, both open and enclosed.

The precautions to be taken against :—

- (a.) Unsuitable switches, fittings, &c.
- (b.) Insufficient earthing of iron piping, motors, &c.
- (c.) Dampness in exposed cables or outside wiring. Vulcanising, concentric and other special systems. Drawing up of a wiring schedule for a small private installation.

Candidates will be expected to have acquired sufficient knowledge of mechanical drawing and sufficient skill in hand sketching to enable them to make a dimensioned sketch roughly to scale which would be understood in the works or drawing office.

(2) Practical Examination.—The Examination will test the Candidates' knowledge of such processes as the following and their ability to carry out any of the operations relating thereto :—

Joints on cables up to  $\frac{1}{2}$  square inch sectional area. Jointing and connecting of lead-covered cables including V.R., or paper insulated concentrics. Making and installing fuses of various capacities. The making of vulcanised joints.



In both Examinations the special material required for the Practical Tests will be provided by and forwarded from the Institute, and must be carefully packed immediately after the examination, and returned carriage paid, to the Offices of the Department.

The fee for the Examination in Grade I (both Written and Practical) is *Five Shillings*.

The fee for the Final Examination (both Written and Practical) is *Ten Shillings*.

Candidates who obtain a First Class Certificate at the Final Examination will be awarded the Institute's Parchment Certificate.

The Examinations in both grades will be held on the following dates :—

Written Examinations, Tuesday, April 30th, 7-10 p.m.

Practical Tests, Saturday, May 4th, 3-6 p.m.

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### 39.—ELECTRICAL ENGINEERING.

The Examinations in Electrical engineering will be held in three grades. The Examination in Grade I will consist of a single paper on the Elements of Electrical Engineering. In Grade II two papers will be set on Continuous Current and Alternate Current work respectively; Candidates will be required to satisfy the Examiners in both sections in order to obtain a Certificate, but the paper in Alternate Current work may be taken, if desired, in a year subsequent to that in which the Candidate has passed in the Continuous Current section. The Final Examination will consist of two papers, (1) a general paper on the Design, Testing, etc., of Electrical Apparatus, (2) a paper with separate questions on the four principal sections of Electrical Engineering. Candidates will be required to satisfy the Examiners in the General Paper, and in one of the four sections of the Second Paper in the same year in order to secure a pass.

No Certificates will be granted on the results of the Examination in Grade I, but the Candidates' successes will be notified. Pass Certificates only will be awarded on the results of the Examination in Grade II. Certificates, First and Second Class, will be issued on the results of the Final Examination to those Candidates only who have passed, in addition to the Institute's Examination, certain Examinations of the Board of Education (see p. 176). The Certificates so issued will be Full Technological Certificates. No provisional Certificates will be issued in this subject.

Every Candidate for Examination will be required to produce evidence of having satisfactorily attended, during the session preceding examination, a course of lecture and laboratory instruction in the subjects of examination at a class registered by the

Institute. The Institute will accept, for the present, a Certificate from the Instructor of the Class, countersigned by the Principal or Secretary of the School, as evidence of such attendance. Applications from Candidates for some relaxation of this condition by reason of their being actually engaged in professional work will be separately considered. Such an application must be made to the Department at least a fortnight before application for examination is made to the Local Secretary.

### GRADE I.

I. Syllabus.—The Examination will include questions in the following subjects :—

1. *Electrical Measurements*.—Applications of Ohm's law. Simple methods of measuring resistance, E.M.F. and current. Chief types of ammeters, voltmeters, wattmeters, and supply meters.

2. *Electrical Properties of Materials*.—Conductors and insulators. The effect of commonly occurring conditions, such as moisture, heat, &c. Conditions which hasten deterioration.

3. *Magnetic Properties of Materials*.—The magnetisation of iron by electric currents; permeability; the law of ampere turns; electro-magnets and simple applications of the principle of the magnetic circuit.

4. *Secondary Batteries*.—The various types; their installation and practical treatment. Precautions in charging and discharging. Testing state of cell by hydrometer and voltmeter.

5. *Electric Lighting*.—Carbon and metal filament lamps. Nernst lamps. Arc lamps. Current and voltages required by the more commonly used glow lamps. Methods of testing. Photometry and illumination.

6. *Electrical Machinery*.—C.C. and A.C. motors; general principles of action; the practical importance of the back E.M.F. and conditions of producing it; field windings and their connections with the armature and the supply circuit; the more commonly occurring causes of breakdowns and their remedies; care of commutators. Starting switches; no voltage and overload release devices; principles involved. Field breaking switches.

C.C. and A.C. Dynamos: their installation and running; regulation by resistance in field circuit; principles involved. Testing of motors and dynamos for insulation; temperature tests under load; testing for faults.

The Examination will be held on Monday, April 29th, from 7 to 10 p.m.

The fee for Examination is *One Shilling and Sixpence*.

## GRADE II.

*Candidates for the Examination in Grade II must in general have previously passed the Examination in Grade I of Electrical Engineering, or the Final Examination in Wiremen's Work. Candidates may, however, be exempted from taking the Examination in Grade I on producing Certificates from the Professors of the Technological or Engineering Faculty of any University, or from the Principals of such other Institutions as may from time to time be approved, that they have acquired an adequate knowledge of the subjects included in the Syllabus for Grade I as set forth in the Institute's Programme.*

The Examination will consist of two papers and will include questions on the following subjects :—

*Continuous Current.*—Scientific and commercial units and measurements.

Measuring instruments and testing.

The electric and mechanical properties of materials ; conductors, insulators.

The magnetic properties of materials ; laws of the magnetic circuit and calculations thereon.

C.C. Generators and Motors ; principles of and essential parts ; elements of design and simple calculations connected therewith ; calculations of and tests for losses and efficiencies.

Secondary batteries ; principles of ; usual forms ; testing, setting up and maintenance.

Electric lamps and lighting ; glow, arc, mercury vapour, and other lamps ; principles involved, use and testing.

Power transmission and distribution by continuous currents.

Electric traction by continuous currents.

*Alternate Current.*—Principles of alternate current working ; elementary mathematical theory ; units and simple measurements.

Alternate current power, principles and details of measurement of.

A.C. Generators and Motors ; principles of and essential parts, elements of design and simple calculations connected therewith ; various types of motors ; circle diagrams ; testing.

Transformers and converters ; necessity for ; various types ; elements of design ; simple calculations concerning ; testing.

Power transmission and distribution by alternate currents.

Electric traction by alternate currents.

The Candidate is permitted to take the paper in Alternate Current work either in the same year as the paper in Continuous Current work, or subsequently, and a Certificate in Grade II of Electrical Engineering will be awarded when he shall have passed both parts of the examination. When a candidate takes both parts in the same year, and passes in Alternate Current work alone, he cannot qualify for a Certificate without again presenting himself for, and passing, both parts of the Examination. Prizes will be awarded on the results of the examination in Alternate Current work to candidates who have passed, either previously or in the same year, the examination in Continuous Current work. The successes of candidates in Continuous Current work will be notified to the Centre at which they were examined, but no Certificates will be awarded on the results of this paper alone.

The Examinations will be held on Monday, April 29th (First Paper), and Wednesday, May 1st (Second Paper), from 7 to 10 p.m. each day.

The fee for either paper is *One Shilling and Sixpence*, for the whole Examination *Three Shillings*.

#### FINAL EXAMINATION.

*Candidates for the Final Examination must hold a Certificate in Grade II. For the present a Certificate in the Ordinary Grade Examination in this subject held in 1907 and previously will be accepted.*

Two papers will be set, both of which must be taken in the same year. The first paper will contain numerical and mathematical questions on the design, working and testing of electrical apparatus, and will include questions upon the winding of magnets and armature coils, properties of materials, losses in machinery, and the action of instruments. In the Final Examination, the Candidate may, during the Examination, use an Electrical Engineering Pocket Book ; but if he avails himself of this, he must state the title of the book on his answer paper, and in his answers give references to the pages of the book he has consulted.

The second paper will be set in four sections, but no Candidate will be allowed to answer questions from more than one section. The Examination in each section will include more advanced questions on the relevant portions of the Syllabus for Grade II in addition to the following subjects :—

SECTION I. *Electrical Machinery Design*.—Properties of materials, design, manufacture and testing of C.C. and A.C. generators and motors, transformers and regulators.

**SECTION 2. *Electrical Instruments and Apparatus.***—Properties of materials, electrical measurements. The underlying principles, details of design, manufacture and calibration of switchboard and laboratory instruments, testing sets, meters, standards and standardising instruments.

Construction and testing of switches, protective devices and auxiliary apparatus.

Switchboards, principles and details of construction and arrangement of various types.

**SECTION 3. *Generation and Traction.***—Generating stations, factors influencing choice of site, plant, general arrangements, working and control, capital charges and running costs.

Principles and details of systems of electric tramway and railway engineering ordinarily used—permanent way, lines and feeders, surface and conduit systems, collection and control of current, capital charges and running costs.

**SECTION 4. *Distribution.***—High voltage transmission systems, details of erection, construction, testing, maintenance—safety devices, limitations of voltage.

Sub-Stations, choice of positions, plant, general arrangement, working and control. Use and maintenance of secondary batteries.

Medium and low voltage distribution systems, details of construction, testing, maintenance.

Consumers' circuits and connections—meters, plant, lighting, public and private.

The Examinations will be held on Monday, April 29th, and Wednesday, May 1st, from 7 to 10 p.m. each day. The fee for the whole Examination will be *Five Shillings*.

**II. Full Technological Certificate.**—Full Certificates will be awarded to Candidates who have passed, in addition to the Institute's Examination, the Examination of the Board of Education in Stage II. of Steam, or Machine Construction, or Applied Mechanics. *Provisional Certificates will not be issued.*

**III.—Works of Reference.**—"Absolute Measurements in Electricity and Magnetism," by A. Gray (Macmillan); "Practical Electricity," Ayrton (Cassell); "Dynamo Electric Machinery," by S. P. Thompson (Spon); "Design of Dynamos," by S. P. Thompson (Spon); "Alternate Current Working," by A. Hay (Biggs); "Alternating Currents," by A. Hay (Harper); "Continuous Current Engineering" by A. Hay (Constable); "Electrical Distributing Networks and Transmission Lines," by A. Hay (Cassell); "Magnetic Induction," by J. A. Ewing ("Electrician" Office); "Storage

Batteries," by Wade ("Electrician" Office); "Electrical Engineering," by Slingo and Brooker (Longmans); "The Dynamo," by Hawkins and Wallis (Whittaker); "Continuous Current Dynamos," by Fischer-Hinnen (Biggs); "Photometry," by A. Polaz; "Principles of Photometry," by Stine (Macmillan); "Transformers," by G. Kapp (Whittaker); "Dynamo Construction," by Kapp (Biggs); "Dynos, Alternators and Transformers," by Kapp (Biggs); "Technical Electricity," by Davidge and Hutchison (Clive); "Foundations of Alternating Current Theory," by Drysdale (Arnold); "Practical Electricity and Magnetism," by J. Henderson (Longmans); "Elementary Treatise on Electricity and Magnetism," by G. Carey Foster and A. W. Porter (Longmans); "Electricity Meters," by Solomon (Griffin); "Experimental Electrical Engineering," by V. Karapetoff (Wiley and Sons); "Calculus for Engineers," by Perry (Arnold); "The Alternate Current Transformer," by J. A. Fleming ("Electrician" Office); "Laboratory Handbook," by J. A. Fleming ("Electrician" Office); "The Electromagnet," by S. P. Thompson (Spon); "Electric Light Cables and the Distribution of Electricity," by S. A. Russell (Whittaker); "Electric Railways and Tramways," by Dawson ("Engineering" Office); "Polyphase Currents," by S. P. Thompson (Spon); "C.G.S. System of Units," by Everett (Macmillan); "Alternating Current Machinery," by D. and J. Jackson (Macmillan); "Electrical Traction," by Wilson and Lydall (Arnold); "Electrical Engineering," by A. Thomalen (Arnold); "Direct Current Electrical Engineering," by J. R. Barr (Whittaker); "Electricity Control," by L. Andrews (Griffin). The current electrical periodicals. The Journal of the Institution of Electrical Engineers.

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#### 40.—ELECTRO - METALLURGY; INCLUDING ELECTRO-LYTIC REFINING, ELECTRIC SMELTING AND ELECTRO-PLATING.

With the view of encouraging artisans and others engaged in these allied trades to take continuous courses of instruction, the examinations will be divided into three grades, of which Grade I will be of an elementary character. No certificates will be given to candidates on the results of the Examination in Grade I only, but their successes will be notified to the centre at which they were examined.

The Examination in Grade I is intended to test the Candidate's knowledge of the fundamental laws of Chemistry and Physics upon which electro-metallurgical work is based, and his understanding of their application to his subject. A general elementary knowledge (but not more) will therefore be required of the subjects named in the Syllabus for this examination and of similar kindred

subjects, a knowledge of which is necessary to ensure a right understanding of those named.

In the Examination in Grade II, more advanced questions will be set in the subjects required for the preliminary examination, and, in addition, a knowledge will be required of the special subjects covered by the Syllabus for Grade II. This latter Syllabus is divided into two sections: (A) Electro-deposition, for students taking up electrolytic refining and electro-plating; and (B) Electric Smelting for those taking up the furnace processes of electro-metallurgy. Every candidate will be called upon to answer questions in Section (A) or in Section (B), but will not be permitted to select his questions from both sections, and in addition will be required to answer certain general questions bearing on the theory and processes common to both sections.

In the Final Examination a further sub-division is made, electro-deposition being divided into electrolytic refining and electro-plating. No candidate will be allowed to take up more than one of the three alternative subjects in addition to the general questions which are applicable to all.

In this examination more advanced questions may be set in any of the subjects named in the syllabuses for Grade II or Grade I, and any questions may be asked on the subjects covered by each section, such as an expert electro-metallurgist, who has devoted himself specially to such subjects, may reasonably be expected to answer.

## I. Syllabus.

### GRADE I.

The Examination in Grade I will include questions founded on the following subjects; only a general elementary knowledge is expected.

1. Elements and Compounds. Atoms and Molecules. Radicals Metals and non-metals; characteristics of each class. Electro-positive and electro-negative elements. The so-called electro-chemical series. Valency. Chemical symbols and formulæ.

2. Formation of bases, acids, salts, hydrates. Generation of heat by chemical action. Chemical reactions and use of equations.

3. Electricity generated by chemical action. Action of electric currents on water, and on compounds dissolved in water. Electrolytes and non-electrolytes.

4. Conduction of electricity by solids and by liquids. Conductors and non-conductors. Relation of quantity of current flowing to weight of matter transported in electrolysis. Calculation of amount of various metals deposited by a given quantity of current.

5. Resistance, electromotive force, potential difference. Ohm's law. Flow of electricity in conductors, simple and divided or shunted.

6. Principles of construction and characteristics of primary and secondary batteries. Variations in E. M. F. resulting from different chemical reactions. E. M. F. required to decompose different compounds.

7. Magnetic and thermal effects of an electric current.

8. Principles of construction and use of the several parts of a dynamo and electric motor.

9. Differences between continuous and alternating currents.

10. Principles and use of simple typical measuring instruments, such as ammeters, voltmeters, galvanometers, voltameters, and of resistance coils.

11. Units, such as volt, coulomb, ampere, watt, kilowatt, horsepower, ohm, joule, calorie, kilowatt-hour, etc.

12. Deposition of metals by simple immersion and with the aid of a current.

13. General principles of construction of vats and tanks for electrolytic work; and means and apparatus used for making electrical connections.

14. Use of terms such as electrode, anode, cathode, anion, cation, electrolyte, &c.

15. Cleansing of metallic surfaces from grease, rust, and films of tarnish, with simple chemical (or physical, as the case may be) explanations of the action. Construction and use of tools for polishing, scratch-brushing and burnishing.

The Examination in Grade I will be held on Monday, April 29th, from 7 to 10 p.m. The fee for examination is *One Shilling*.

## GRADE II.

More advanced questions may be set in the subjects covered by the Syllabus for Grade I, and in addition a knowledge will be expected of the following:—

### *General Syllabus.*

1. Simple chemical and physical properties of the principal metals, acids, bases and salts used in electro-metallurgy.

2. Means of obtaining adhesive or non-adhesive deposits electrolytically. General principles of electro-plating, electro-typing and electrolytic refining.

3. Use and effect of using soluble and insoluble anodes.



4. General effect of heat upon conductivity of metallic and electrolytic conductors.
5. General ideas as to application of electric motors for driving tools and appliances of electro-metallurgical and plating works.
6. Use of public electricity supply as source of current. Supply meters.

### *Section A.*

#### ELECTRO-DEPOSITION (REFINING AND PLATING).

1. Preparation of solutions—Measurements of specific gravity by hydrometers. Uses of special hydrometer scales.
2. Arrangements of baths, instruments and resistances. General plan and design of plating and refining plants.
3. Composition of baths and details of electroplating with copper (acid and alkaline baths), silver (ordinary and "bright"), gold, nickel and iron.
4. Electrotyping from engraved plates, blocks and standing type.
5. Preparation of different objects for the plating bath. The rendering of non-metallic surfaces conductive.
6. Stripping of old coatings of copper, silver, gold, nickel and iron.
7. Suspension of objects in the plating or refining tank.
8. Electro-plating of internal and irregular surfaces.
9. Recovery of copper, silver, gold and nickel from old solutions.
10. Finishing of plated goods. Production of "oxidised" and "nielled" silver.
11. Production of dead silver and dead-gold deposits.
12. Stopping out. Parcel work. Quickening.
13. Electrolytic refining of crude metallic copper.
14. Arrangement of baths in series and in parallel. "Multiple" and "Series" arrangement of electrodes in bath.
15. Current densities and pressures used in electro-plating and refining respectively.
16. Means for and effect of circulating solutions, or moving electrodes during electrolysis.
17. Mechanical scouring and burnishing of objects during electrolysis.
18. Use of diaphragms in electro-deposition.

### *Section B.*

#### ELECTRIC SMELTING AND FURNACE WORK.

1. Elementary classification and construction of electric furnaces.

2. Distinction between electrolytic and electro-thermal processes. Use of alternating currents in electric furnace work.
3. General knowledge of properties of electric arc.
4. Judging of high temperatures by eye. Elementary knowledge of construction and use of pyrometers, including platinum thermometers.
5. General knowledge of fusing and boiling points of metals and salts used in electric furnace work.
6. General knowledge of electrical and chemical behaviour of furnace materials and metals used in construction at high temperatures when exposed to air, reducing-gases, reduced metals (including sodium, aluminium, &c.), and chlorine.
7. Reduction of aluminium and sodium, and production of calcium carbide and graphite by electric furnace methods.

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The Examination in Grade II and the Final Examination will be held on Tuesday, April 30th, from 7 to 10 p.m. The fee for either Examination is *One Shilling and Sixpence*.

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#### FINAL EXAMINATION.

More advanced questions may be set in the subjects required for the Examinations in Grade I and Grade II, and, in addition, a knowledge will be expected of the following subjects; but any questions may be set such as a practical electro-metallurgist should be able to answer.

#### *General Syllabus.*

1. Specific resistances of metals and electrolytes, polarisation of electrodes. Thermo-chemical theory as to electromotive force necessary to maintain electrolysis. Methods of determining the resistances of solids and liquids and the differences of potential in cells.
2. The ionic theory of electrolysis, and meaning and use of the various terms employed in this and other theories.
3. Effect of suspending metals from insulated supports between the electrodes during electrolysis.
4. Conversion of alternating into continuous currents and reduction of pressure.
5. Drop of volts in conductors and size of mains and conductors for various currents. Loss of electrical energy in mains, conductors and baths. Calculation of power required for various electro-metallurgical processes and calculation of efficiency of such processes.

*Section A.*

## ELECTRO-PLATING AND ELECTRO-TYPING.

1. Electro-deposition of cobalt, platinum, palladium, lead, tin and zinc. Composition of baths, current densities and pressures required, and difficulties in regard to plating with these metals.

2. Electro-deposition of brass, German silver and other alloys. Production of coloured gold deposits. Effect of varying conditions upon nature of alloy deposited.

3. The making of moulds in plaster, wax, gutta percha, gelatine, elastic and various compositions. Rendering of plaster moulds impervious to liquid. Galvanoplastic processes for reproducing busts, statues, &c., in copper. Methods of bronzing.

4. Testing the purity of silver, gold; analysis of silvering, gilding, and other solutions used in electrolysis. Assay of potassium cyanide.

5. Circumstances affecting the purity of electrolytic deposits. Behaviour of anode impurities during electrolysis.

6. Effect of varying the current density upon the strength and physical characteristics of electro-deposited copper.

*Section B.*

## ELECTROLYTIC REFINING.

1. Arrangement of vat rooms and plant generally. Use of travelling cranes. Circulation of, and pumps for, solutions. Arrangement and use of instruments for the observation and control of electrolytic work. Use of recording instruments. Arrangement of vats and electrodes.

2. Comparison of multiple and series systems of refining.

3. Electrolytic treatment of copper mattes as anodes, and of the liquids obtained from them by independent solution.

4. Electrolytic refining and treatment of silver and gold and their alloys, and of nickel, zinc, antimony and other metals. Behaviour of anode-impurities and their effect on the purity of the deposit.

5. Effect of varying the current-density upon the strength and physical characteristics of electro-deposited copper.

*Section C.*

## ELECTRIC SMELTING AND FURNACE OPERATIONS.

1. Construction and use of direct-reading and recording

2. Variations in chemical reactions at high and ordinary temperatures.

3. Reduction of magnesium and alkali- and alkaline-earth metals, zinc, lead and other metals at furnace temperatures. Production of carbides, borides and silicides, and of rarer metals and refractory alloys.

4. Treatment of iron ores. Refining of steel. General knowledge of the practice of electric welding.

5. General knowledge of the processes for reduction of metals by means of aluminium and by calcium carbide.

6. General knowledge of the testing of furnace products and charges.

7. Construction and use of alternate-current transformers.

II. Full Technological Certificate.—For the Full Technological Certificate, the Candidate will be required to qualify as stated in Rules 29 and 30.

III. Works of Reference.—R. A. Lehfeldt's "Electro-Chemistry, Part I., General Theory" (Longmans); W. G. McMillan's "Treatise on Electro-Metallurgy" (Griffin); Henri Moissan, "The Electric Furnace," translated by A. T. de Mouilpied (Arnold); Borchers' "Electric Smelting and Refining," 2nd English edition translated by W. G. McMillan (Griffin); Watt and Philip, "Electro-plating and Electro-refining of Metals" (Crosby Lockwood); Titus Ulke, "Modern Electrolytic Copper Refining" (Chapman & Hall); Gore's "Art of Electro-Metallurgy" (Longmans); Gore's "Electro-Chemistry" (The "Electrician" Publishing Co.); Gore's "Art of Electrolytic Separation of Metals" (The "Electrician" Publishing Co.); Pfanhauser, "Die Herstellung von Metallgegenständen auf electrolytischem Wege" (Halle-Knapp); Langbein, "Vollständiges Handbuch der galvanischen Niederschläge" (Leipzig); Electro-Chemical Industry (Periodical).

#### 41.—METAL PLATE WORK.

I. Syllabus.—The Examination will include questions founded on such subjects as the following:—

##### GRADE I.

1. Calculation of dimensions of vessels to hold given quantities; sizes of main and branch pipes for stoves and ventilating purposes. Weights, sizes and gauges of sheets, wire, rivets, &c.

2. The setting-out of patterns for elbows formed by circular, oval, and oblong pipes meeting at any angle ; T-elbows, tapering Y-pieces, bends, &c. Patterns for round, oval, oblong, and other simple forms of equal tapering bodies used by boilermakers, copper-smiths, iron, zinc, and tinplate workers.

3. Shape of notches, and allowances for lap, wire, &c., for seams of various kinds. Methods of joining sheet metal by—(a) soldering, (b) riveting, and (c) grooving.

4. Solders and soldering. Composition and uses of hard and soft solders. Theory and practice of soldering, brazing, autogenous soldering, fluxes, useful alloys, &c.

5. Annealing, stretching, raising, planishing, and general principles of working up sheet copper, brass, zinc, iron (plain and coated).

6. The various hand and machine tools used in metal plate work. Comparison of hand and machine tools for special work.

It is important that candidates should acquire facility in the production of clear and neat working drawings, and give answers which show their practical connection with some branch of metal plate work. *Drawing paper is provided by the Institute, but all necessary instruments must be provided by the Candidates or the School.*

#### FINAL EXAMINATION.

*Candidates for the Final Examination must hold a Certificate in Grade I.*

Candidates for the Final Examination will be required to pass a Written Examination and to submit specimens of their practical work.

(1.) **Written Examination.**—In the Written Examination more difficult questions will be set in some of the above subjects, and in addition candidates will be required to show a knowledge of :—

1. The physical and chemical properties of iron, lead, antimony, aluminium, bismuth, mercury, tin, zinc, copper, nickel, and silver.

2. Alloys. The composition and properties of brasses, bronzes, tin-plate, galvanised iron, &c. Tinning processes.

3. Fuel : composition and physical character of various kinds, and the modes of applying them in metal plate work.

4. Patterns and working drawings to scale of a more advanced character will be required.

*Drawing paper is provided by the Institute, but all necessary*

(2.) Specimen Work.—Each candidate will be required to execute in suitable material, in the year preceding the Examination, an original piece of work, and to forward the same to London (carriage paid) on or before April 29th. The specimen of work must be accompanied by a working drawing, with particulars of the quantity and nature of the materials used, and must be of such dimensions that it can fit into a box not larger than two cubic feet. The work should be such as will show the candidate's skill in the more important branches of metal work in which he is engaged and should not be painted; specimens should be of a practical character and not mere models. A certificate signed by the candidate's employer, or by the Class Teacher and a Member of the School Committee, stating that the work has been executed by the candidate himself, without assistance, *must be forwarded with the specimen*. In cases where the work has been executed at the candidate's own residence, a Statutory Declaration will be required. Forms for either the Certificate or the Declaration may be obtained on application.

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The Written Examination in both Grades will be held on Thursday, May 2nd, 7 to 10 p.m. The fee for Examination in either Grade is *One Shilling and Sixpence*.

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II. Full Technological Certificate.—For the Full Technological Certificate, the candidate will be required to qualify as stated in Rules 29 and 30; but certificates showing that he has passed the Examinations of the Board of Education in Geometrical Drawing, as well as in Freehand or Model Drawing, will be accepted in lieu of one of the Science Certificates.

III. Works of Reference.—Byrne, "Practical Metal-Worker's Assistant" (Baird, Philadelphia, and Spon, London); Bloxam and Huntington, "Metals" (Longman, Green & Co.); "Metal Plate Work," C. T. Millis (Spon); "Practical Sheet and Metal Plate Work," E. A. Atkins (Whittaker).

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## 42.—PLUMBERS' WORK.

The course of instruction in the Technology of Plumbers' Work should include lessons on the principles and practice of Plumbing and Sanitary Work, illustrated by models and other apparatus, and practical exercises in the plumbers' workshop, and is intended to cover three years. There will be three corresponding examina-

The examination in Grade I will be a written examination only on the elements of plumbers' work and the applications of physical principles thereto; no certificate will be awarded on the results of this examination. The examination in Grade II and the Final Examination will each consist of two parts, a written examination in the theory and principles of the subject, and a practical test of workmanship. To obtain a certificate in "Plumbers' Work" on the results of either of these two examinations the candidate must pass both parts of the examination: pass Certificates only will be awarded on the results of the examination in Grade II and First and Second Class Certificates on the results of the Final Examination. In the award of prizes in both grades, and in the division of the successful candidates into two classes in the Final Examination, the results of both parts of the examination will be taken into account.

Apprentices are strongly recommended to attend a two years' course of instruction in Elementary Science, Geometry, Workshop Drawing and Calculations, before attending the course of instruction adapted to the examination in Grade I of the Technology of Plumbers' Work. The course of instruction should be based on the Syllabuses of the Board of Education in Subject Vp., "Practical Mathematics," Stage I. and in Subject XXVI., "Elementary Science of Common Life"; Candidates who pass the examinations in these two subjects will be considered qualified to enter the first year's course in the Technology of Plumbers' Work. It is desirable that students not possessing these qualifications should be required to pass an entrance examination, to be held by the School Authorities, in the subjects of Elementary Science, Practical Mathematics and Workshop Drawing.

Candidates, not being plumbers, who wish to present themselves for the Written examination only, will receive on passing the Written examination in Grade II or the Final Written Examination a certificate of that grade in "The Principles of Lead Work and House Sanitation." The same certificate will be awarded to plumbers who succeed in passing the Written examination only.

## I. Syllabus.

### GRADE I.

The examination in Grade I in the Technology of Plumbers' Work will be a written examination only, and will include questions founded on the following subjects in their relation to plumbing:—

1. *Workshop Arithmetic, Geometry and Drawing.*—The setting out of sheet lead in various forms for covering dormers, cesspools. Making simple plans, elevations, and sections, and rough dimensioned sketches of various details in plumbers' work. Capacity of pipes of various dimensions.

2. *Simple applications of Elementary Physics to Plumbers' Work.*—Expansion and contraction due to changes of temperature;

frostburst. Flow of metals, as of lead under great pressure, or in bossing. The principles of workshop appliances such as the lever, windlass, pulley blocks and screw jacks.

3. *Alloys, Solders, etc.*—Properties, composition and preparation of different kinds of solders and other alloys used in plumbers' work; fusing points; means of purification.

4. The various hand tools used by plumbers, their use and maintenance. Reasons for the forms and materials of given tools.

5. The making of soldered seams and joints; fluxes and their use.

6. The cutting and straightening of sheet lead. Lead bossing.

7. *Roof Work.*—The proper formation of gutters, flats, valleys in order to render them damp and waterproof. Flashings and soakers for rendering weather proof the junctions of roofs, walls and chimneys. Methods of conveying rainwater from roofs.

8. The nature and uses of oil and rust cements in plumbers' work.

The examination in Grade I will be held on Monday, April 29th, from 7 to 10. The fee for the examination is *One Shilling and Sixpence*.

## GRADE II.

Candidates, as a rule, will be required to have passed the Examination in Grade I before being admitted to the Examination in Grade II. For the present, however, on the recommendation of their teachers and with the approval of the Institute, Candidates of not less than 21 years of age may enter for Grade II without having passed in Grade I.

The examination in Grade II will consist of a written examination and a practical test in workmanship.

The practical test may not be taken in any year prior to the written examination, but may only be taken in the same year as, or subsequently to, the written examination. Only those candidates will be eligible for prizes who pass both parts of the examination in the same year. No certificates are awarded on the results of the practical examination alone, but the successes will be notified.

(1.) *Written Examination.*—The written examination will include more difficult questions on the subjects of the Syllabus for Grade I, and, in addition, knowledge will be required of the following subjects:—

1. *Workshop Arithmetic.*—Decimal and duodecimal fractions and the extraction of square roots. The mensuration of irregular plane surfaces or figures, including dome and turret roofs. Solid and superficial mensuration of cylinders, cones and other regular solids.



*Workshop Geometry.*—Finding the true length of hips, stepped or raking flashings and other sloping work from a roof plan either algebraically or by geometry. The development of plain turrets and method of setting out the covering surface of same. Other regular solids.

*Workshop Drawing.*—Making scales, measurements and setting out of angles. Making working drawings (full size or to scale) to show the arrangement of soil or other large pipes for a single sanitary fitting.

2. *Applications of Science to Plumbers' Work.*—Water : soft, hard, mineral and sea waters, and their effects upon pipes, cisterns, etc. : temporary and permanent hardness ; contamination of water. Head of water ; flow of water in channels and pipes ; the syphon ; lift and force pumps, rams and hydraulic jacks.

Atmospheric pressure ; movement of air or gas through pipes, as in the distribution of coal gas ; elasticity of gases.

The principle of the Bunsen burner ; the oxy-hydrogen and air-hydrogen blow pipe ; the use of compressed gases in cylinders, as applicable to plumbers' work.

*Lead Burning.*—Its special advantages ; different methods in use ; hydrogen generators ; precautions to be taken in the use of generators.

3. *External Roof Work.*—Covering turrets and domes. Lining cesspools. Fixing socket pipes. Joining sheet lead by hollow or seam rolls, also by double and single welts. Laps and drips. Capillary attraction and the use of "water grooves." Condensation gutters and their use. Crawling of lead and how to prevent it. Advantages of copper nails over those made of iron. The proper arrangement of the woodwork in roofs to support the plumber's work.

4. *Cold Water Supply.*—Connection of pipes to mains, methods of fixing pipes, house cisterns, their construction and fittings, valves, taps, water waste preventers, flushing tanks, stop and draining cocks, warning pipes, water hammer, causes of noises in pipes and ball valves, air traps, practical means of protection against frost, tracing leakage.

5. *Hot Water Supply.*—Systems of supply, storage, and arrangement for best results, safety arrangements, the cause and prevention of collapse of cylinders, cause and prevention of incrustation, cause and prevention of boiler explosions, the different forms of safety valves, the relations of temperature and pressure. Expan-

sion of water by heat. General principles of conduction, convection and radiation. Circulation of water in pipes and boilers. Cylinder and tank systems of domestic water supply. "Range" and "Independent" boilers. Materials for cocks and valves and for packing manholes. Elasticity of metals; tension and compression; strength of pipes and boilers; calculation of bursting pressure and safe load.

6. The use of cast and milled lead, the advantages and disadvantages of each. The use of cast and drawn lead pipe, bends, and traps. Tinned and tin encased pipes. Galvanizing and other methods of protecting pipes.

7. *Pipe Fitting*.—The cutting, bending, screwing, jointing and fixing of iron, copper and other metal pipes used for hot and cold water supplies, waste pipes, etc.

8. *Sanitary Appliances in common use and the Principles of their Action*.—Forms and materials for baths, lavatories, sinks, urinals, water closets, and their fittings and methods of fixing; forms and principles of the various traps used in plumbers' work and their relative advantages; waving out and syphonage of traps, and methods of preventing the same.

9. *Drainage*.—The fitting up, arrangement and ventilation of soil and waste pipes.

(2.) *Practical Test*.—A practical examination may be held at any centre where at least five candidates present themselves; otherwise special arrangements must be made as in the case of the Practical Test for the Final Examination, see p. 191. The material required for the examination must be provided by the school committee or by the local education authority from a specification furnished by the Department, and the candidate's work, which will be executed in the presence of a local examiner appointed by the Department, will be required to be transmitted to London after the examination for final marking by the chief examiners. The carriage will be paid by the Department and the empty cases returned carriage paid, if desired. In cases where the local examiner and the school authorities concur in considering that the work is clearly not sufficiently well executed to be awarded a pass, the material need not be forwarded to London for examination.

The examination will be such as to test the candidate's ability to mark off and cut out sheet lead, to bend and wipe joints on lead pipes up to four inches in diameter, and to boss lead including internal and external angles up to six inches high.

The fee for the written examination is *One Shilling and Sixpence*. No additional fee is charged for the practical test when taken in the

same year as the written examination, but if taken subsequently the fee is *One Shilling*.

The practical examination in Grade II will be held on **Saturday, May 11th**, from 2.30 to 8, with a half-hour's interval.

The written examination in Grade II and the Final Written Examination will be held on **Thursday, May 2nd**, from 7 to 10.

### FINAL EXAMINATION.

*Candidates for the Final Examination must hold a Certificate in Grade II.*

The Final Examination in Plumbers' Work will consist of a written and practical examination which must be taken in the same year.

(1.) **Written Examination.**—In the Final Examination more difficult questions will be set in the subjects of the previous grades, and in addition a knowledge will be required of :—

1. *Workshop Arithmetic.*—Taking out quantities for internal work ; measuring and squaring up external or roof work and plumbers' work generally. Calculating proper sizes for house drains, also of water services and waste pipes. Calculating sizes of cisterns for storing water. Relative capacities and discharging powers of pipes.

*Workshop Geometry.*—The development of domes, turrets and finials and other rounded or hollow roofs, with the lines necessary for finding the true shape of a piece of metal for roof covering.

*Workshop Drawing.*—Setting out, full size or to scale, all kinds of internal plumbers' work ; setting out on plan the proper positions of cesspools, rolls, drips and other lead work on roofs. Making sketches and working drawings.

2. *Water.*—Sources of water supply, qualities and properties of water from deep and shallow wells, springs and other sources ; storage, filtration and distribution, causes and prevention of pollution ; quantity per head required for private supply purposes ; rainfall. Flow of water in channels and pipes ; calculation of velocities.

3. *Hot Water Supply and Heating.*—Methods of obtaining large supplies of hot water, calorifiers, water heaters, central stations ; heating buildings by hot water or steam, high and low pressure systems, sizes of pipes and boilers ; radiating surface of heaters, heating surface of boilers.

4. *Ventilation*.—Different systems of ventilating for private dwelling houses and public buildings; ventilation of parts of public buildings in which sanitary appliances are fixed.

5. *Sanitary Appliances*.—The arrangement and fitting of sanitary appliances in hospitals and other public buildings.

6. *Drainage*.—Setting out, construction and principles of town and country house drainage; construction of sewers; storm overflows; sewage gases and ventilation; methods of sewage disposal for isolated country houses; access to and cleansing of drains; the testing of soil pipes, drains, etc., by smoke, water, chemicals, or air pressure.

7. *Plans and Specifications*.—The preparation of specifications and quantities and making of working drawings to scale; measuring work: Local Authorities' bye-laws and regulations.

(2.) *Practical Test in Workmanship*.—A Practical Examination may be held at any centre where at least *five* Candidates present themselves. When the number of Candidates is less than five, special arrangements may be made, either by transfer of Candidates to some other centre, or by the payment by the Local Authority of the whole or of part of the Local Examiner's fee.

The Examination will be of an advanced character, and will be such as to show that the Candidate can properly bend all sized lead pipes, and join them by wiped soldered joints, without the use of lamp or gas jet, or by lead burning, in such positions as would occur in practice, and boss lead to a given form, or execute in a satisfactory manner any other piece of plumbing work.

*The material for the Practical Test in the Final Examination will be supplied by the Institute and forwarded carriage paid.*

The Final Practical Examination will be held on Saturday, May 18th, from 2.30 to 8, with a half-hour's interval.

The fee for the complete Final Examination (Written and Practical) in Plumbers' Work is *Five Shillings*. The fee for those Candidates who take the Written Examination only with a view to qualifying for a Certificate in the Principles of Lead Work and House Sanitation is *One Shilling and Sixpence*.

II. *Full Technological Certificate*.—For the Full Technological Certificate, the candidate will be required to qualify as stated in Rules 29 and 30.

III. *Works of Reference*.—"Elementary Science applied to Sanitation and Plumbers' Work," by A. Herring-Shaw; "Standard

Practical Plumbing," by Davies (E. & F. N. Spon); "Building Construction," by Mitchell (B. T. Batsford); "Treatise on Warming Buildings," by Hood (E. & F. N. Spon); "Hydraulics," by Box (E. & F. N. Spon); "Hot Water Supply," by Dye (E. & F. N. Spon); "Hydrostatics and Pneumatics," by Magnus (Longmans); "External Plumbing Work" (1896), by J. Hart (Scott & Co.); "Plumbing and Sanitation," by Davis and Dye (Spon); "Hints to Plumbers," by Hart (Scott Greenwood); "Pumps," by J. W. Clarke (Batsford); "Hydraulic Rams," by J. W. Clarke (Batsford); "The Modern Plumber and Sanitary Engineer," edited by G. Lister-Sutcliffe (The Gresham Publishing Co.).

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### 43.—SILVERSMITHS' WORK AND ALLIED TRADES.

I. Syllabus.—The Examination, in either grade, will be Practical and Written, and will be divided into sections, corresponding to different branches of the trade. No Candidate may enter for examination in more than one branch in the same year, but a Candidate who has passed in any one section, in either grade, may present himself subsequently for examination in any other section.

#### GRADE I.

(1.) Practical Examination.—The Examination in Grade I will be divided into five sections. Candidates must take the Practical Test in the same branch as the Written Examination, and will be required to show skill in the operations required for that branch.

1. RAISING.—Candidates will be required to raise, with the mallet, a small and simple shape.

2. CHASING AND EMBOSSEING.—A given pattern to be applied and worked out on a given subject; part at least to be quite finished. The pattern must be drawn on the metal, not traced.

3. MOUNTING.—Certain pieces of an object being supplied, the Candidate will be required to join them, or to do other simple mounting and soldering.

4. ENGRAVING.—Make a freehand copy on metal and engrave a pattern or coat of arms, to be supplied; or "write" and engrave a given inscription. Heavy back-lining in engraving should be avoided. It is desirable that lettering should be studied from good models and be simply spaced out. Heraldry inscriptions, monograms, &c., should be studied from good old examples.

5. ENAMELLING.—Work out some simple pattern, such as a shield of arms, and enamel in "Limoges," or execute some suitable exercise in the *champlevé* method.

(2.) Written Examination.—The written examination will include exercises in drawing and will specially bear on the branch of the trade selected by the student, but the Candidate should be prepared to answer one or two general questions relating to the making of silverwork.

(3.) Specimen Work.—Candidates may also submit one or more specimens of their work, in the branch of trade selected, executed in the year preceding the Examination, which will be considered in determining the results of the Examination.

The specimens of work must not exceed 6 ins. in any dimension, and must be accompanied by a working drawing by the Candidate himself. The work done at the Practical Examination, Section (1), together with the specimen work, must be forwarded, *carriage paid*, to London immediately after the Practical Examination. The Class Teacher and a Member of the School Committee will be required to certify that the work has been executed by the Candidate himself. In cases where the work has been executed at the Candidate's own residence, a Statutory Declaration will be required. Forms for either the Certificate or the Declaration may be obtained on application.

The Written Examination in Grade I will be held on **Tuesday, April 30th**, from 7 to 10 p.m.

The Practical Examination will be held on **Monday, May 6th**, from 6 to 10 p.m.

The fee for the entire examination is *Two Shillings and Sixpence*.

#### FINAL EXAMINATION.

*Candidates taking any one section of the Final Examination must hold a Certificate in Grade I for one of the parts of that section.*

The Final Examination will be divided into three sections.  
1. Raising; chasing and repoussé; mounting. 2. Engraving; including advanced knowledge of lettering, and some acquaintance with heraldry. 3. Enamelling; limoges, *champlevé*, and cloison. Drawing and design will be included, also advanced craftsmanship, wider theoretical knowledge, and some history of the craft.

Practical Plumbing," by Davies (E. & F. N. Spon); "Building Construction," by Mitchell (B. T. Batsford); "Treatise on Warming Buildings," by Hood (E. & F. N. Spon); "Hydraulics," by Box (E. & F. N. Spon); "Hot Water Supply," by Dye (E. & F. N. Spon); "Hydrostatics and Pneumatics," by Magnus (Longmans); "External Plumbing Work" (1896), by J. Hart (Scott & Co.); "Plumbing and Sanitation," by Davis and Dye (Spon); "Hints to Plumbers," by Hart (Scott Greenwood); "Pumps," by J. W. Clarke (Batsford); "Hydraulic Rams," by J. W. Clarke (Batsford); "The Modern Plumber and Sanitary Engineer," edited by G. Lister-Sutcliffe (The Gresham Publishing Co.).

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#### 43.—SILVERSMITHS' WORK AND ALLIED TRADES.

I. Syllabus.—The Examination, in either grade, will be Practical and Written, and will be divided into sections, corresponding to different branches of the trade. No Candidate may enter for examination in more than one branch in the same year, but a Candidate who has passed in any one section, in either grade, may present himself subsequently for examination in any other section.

##### GRADE I.

(1) **Practical Examination.**—The Examination in Grade I will be divided into five sections. Candidates must take the Practical Test in the same branch as the Written Examination, and will be required to show skill in the operations required for that branch.

1. **RAISING.**—Candidates will be required to raise, with the mallet, a small and simple shape.

2. **CHASING AND EMBOSSING.**—A given pattern to be applied and worked out on a given subject; part at least to be quite finished. The pattern must be drawn on the metal, not traced.

3. **MOUNTING.**—Certain pieces of an object being supplied, the Candidate will be required to join them, or to do other simple mounting and soldering.

4. **ENGRAVING.**—Make a freehand copy on metal and engrave a pattern or coat of arms, to be supplied; or "write" and engrave a given inscription. Heavy back-lining in engraving should be avoided. It is desirable that lettering should be studied from good models and be simply spaced out. Heraldry inscriptions, monograms, &c., should be studied from good old examples.

5. ENAMELLING.—Work out some simple pattern, such as a shield of arms, and enamel in "Limoges," or execute some suitable exercise in the *champlevé* method.

(2.) Written Examination.—The written examination will include exercises in drawing and will specially bear on the branch of the trade selected by the student, but the Candidate should be prepared to answer one or two general questions relating to the making of silverwork.

(3.) Specimen Work.—Candidates may also submit one or more specimens of their work, in the branch of trade selected, executed in the year preceding the Examination, which will be considered in determining the results of the Examination.

The specimens of work must not exceed 6 ins. in any dimension, and must be accompanied by a working drawing by the Candidate himself. The work done at the Practical Examination, Section (1), together with the specimen work, must be forwarded, *carriage paid*, to London immediately after the Practical Examination. The Class Teacher and a Member of the School Committee will be required to certify that the work has been executed by the Candidate himself. In cases where the work has been executed at the Candidate's own residence, a Statutory Declaration will be required. Forms for either the Certificate or the Declaration may be obtained on application.

The Written Examination in Grade I will be held on Tuesday, April 30th, from 7 to 10 p.m.

The Practical Examination will be held on Monday, May 6th, from 6 to 10 p.m.

The fee for the entire examination is *Two Shillings and Sixpence*.

#### FINAL EXAMINATION.

*Candidates taking any one section of the Final Examination must hold a Certificate in Grade I for one of the parts of that section.*

The Final Examination will be divided into three sections. 1. Raising; chasing and repoussé; mounting. 2. Engraving; including advanced knowledge of lettering, and some acquaintance with heraldry. 3. Enamelling; limoges, *champlevé*, and *cloison*. Drawing and design will be included, also advanced craftsmanship, wider theoretical knowledge, and some history of the craft.



The Examination will include :—

(1.) Practical Work of a more advanced character than for Grade I.

(2.) Written Examination, including more advanced questions on the Candidate's special branch of work, and on Silversmiths' work generally.

(3.) Specimen Work.—Candidates are required to submit one or more specimens of their work, executed in the year preceding the examination.

The specimens of work must not exceed 6 ins. in any dimension, and must be accompanied by a working drawing or design by the Candidate himself. The work done at the Practical Examination, Section (1), together with the specimen work, must be forwarded, *carriage paid*, to London immediately after the Practical Examination. A Certificate signed by the Candidate's employer or by the Class Teacher and a Member of the School Committee, stating that the work has been executed by the Candidate himself, without assistance, *must be forwarded with the specimen*. In cases where the work has been executed at the Candidate's own residence, a Statutory Declaration will be required. Forms for either the Certificate or the Declaration may be obtained on application.

The Final Written Examination will be held on Tuesday, April 30th, from 7 to 10 p.m.

The Practical Examinations will be held on Monday, May 6th, and on Tuesday, May 7th, from 7 to 10 p.m. each day.

The fee for the entire examination is *Two Shillings and Sixpence*.

II. Full Technological Certificate.—For the Full Technological Certificate, the candidate will be required to qualify as stated in Rules 29 and 30, but certificates showing that he has passed the Examinations of the Board of Education in Geometrical Drawing, as well as in Freehand or Model Drawing, will be accepted in lieu of one of the science certificates.

III. Works of Reference.—Starkie Gardner's "Old Silverwork" (Batsford); Cripps, W. J., "Old English Plate" (1894); for lettering and inscriptions see E. R. Strange's "Alphabets"; Lewis F. Day's "Alphabets, Old and New" (Batsford); for Heraldry see Foster's Peerage, St. John Hope's "Stall Plates," Charles Boutell's "Handbook"; G. W. Eve's "Heraldry as Art" (Batsford); "The Art of Enamelling upon Metal," by A. Fisher (The Studio); see also list of Works of Reference in 44, Goldsmiths' Work.

## 44.—GOLDSMITHS' WORK AND ALLIED TRADES.

**I. Syllabus.**—The Examinations, in both grades, will be Written and Practical, and will be divided into four sections, corresponding to different branches of the trade, viz. :—1. Mounting and general goldsmiths' work. 2. Chasing and embossing. 3. Enamelling. 4. Engraving. No Candidate may enter for examination in more than one branch in the same year, but a Candidate who has passed in any one section, in either grade, may present himself subsequently for examination in any other section.

## GRADE I.

**(1.) Written Examination.**—The Written Examination will include a general section containing questions on the principles and processes applicable to all branches of the trade, and special sections on each of the four branches specified above. Candidates will be required to select their questions from the general section and one special section only.

**GENERAL SECTION.** The questions will be founded on such subjects as the following :—

1. The general principles underlying the various branches of the industry. The manufacture of goldsmiths' work, gem work, and the manufacture of personal ornaments.

2. Chasing and embossing. General information respecting these methods of decoration, when applicable, and differences of treatment for cast, solid, and hollow work, tools and processes employed.

3. Enamelling. Principles of the art, with details of the various methods—champlevé, cloison, enamel painting, Limoges, &c. ; processes and materials used, and their effect on precious and other metals.

4. Engraving. Special references to the decoration of gold and silver articles ; tools and processes used.

**SPECIAL SECTIONS.** The questions set will deal in more detail with the processes used and the principles controlling the particular industry. Students will be required to show that they have some training in drawing and design as applicable to the group selected, and a general knowledge of its practice.

**(2.) Practical Examination.**—Candidates must take the Practical Test in the same branch as the Written Examination, and will be required to show skill in the operations required for that branch.

1. **MOUNTING AND GENERAL GOLDSMITHS' WORK.**—Make up some specified ornamental form as a test of mounting and soldering.

2. CHASING AND EMBOSSING.—Draw (not trace) on metal a copy of the outline or cast supplied ; chase, emboss, and finish same.

3. ENAMELLING.—Draw (not trace) the outline supplied ; cut out, or make pattern in cloison wire supplied, fill in with two or more colours as required, and fire.

4. ENGRAVING.—Make a freehand copy on metal of the outline supplied ; engrave and add appropriate detail.

Four hours will be allowed for each test.

(3.) Specimen Work.—Candidates may also submit one or more specimens of their work, executed in the year preceding the Examination, which will be considered in determining the results of the Examination.

The specimens of work must not exceed 6 ins. in any dimension, and must be accompanied by a working drawing by the candidate himself. The work done at the Practical Examination, Section 2, together with the specimen work, must be forwarded, *carriage paid*, to London immediately after the Practical Examination. The Class Teacher and a member of the School Committee will be required to certify that the work has been executed by the Candidate himself. In cases where the work has been executed at the Candidate's own residence, a Statutory Declaration will be required. Forms for either the Certificate or the Declaration may be obtained on application.

The Written Examination in Grade I will be held on Wednesday, May 1st, from 7 to 10 p.m.

The Practical Examination will be held on Wednesday, May 8th, from 6 to 10 p.m. and at other times if found necessary.

The fee for the entire examination is *Two Shillings and Sixpence*.

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### FINAL EXAMINATION.

*Candidates taking any one section of the Final Examination must hold a Certificate in that section of Grade I.*

(1.) Written Examination.—The examination will include a general section and separate sections corresponding to the different branches of trade, and Candidates will be required to answer questions from the general section and from one special section only.

1. MOUNTING AND GENERAL GOLDSMITHS' WORK.—More

difficult questions will be set on the subjects included under Grade I and a knowledge will be expected of the following:—

The different qualities and alloys of gold and the solders required.

The different processes, mechanical and otherwise, used in the manufacture of jewellery.

Modelling and casting as applied to the Goldsmiths' industry.

Precious stones, pearls, and other materials, used in personal ornaments, and their distinctive qualities.

Setting of precious stones in various methods, and their harmonious arrangement.

Drawing and design for Goldsmiths' and Jewellers' work.

2. CHASING AND EMBOSSING.—The relation of these arts to the gold and silver working trades.

General principles of chasing and embossing and kindred methods of decoration in flat or relief.

An acquaintance with the historical development of the art and also of drawing and design applicable to the subject.

The alloys of gold, silver, and other suitable metals chiefly used.

3. ENAMELLING.—Study of the different methods of enamelling with some knowledge of historical styles and methods, and their influence on modern work.

Design as applied to the art of enamelling.

The alloys of suitable metals.

4. ENGRAVING.—The historical development of engraving. The different styles, such as heraldic, ornamental, and inscription, with examples of design in one or more branches.

## (2.) Practical Examination—

1. MOUNTING AND GENERAL GOLDSMITHS' WORK.—The Candidate must make and finish as far as possible some object of personal ornament as directed, which may include mounting for gems.

2. CHASING AND EMBOSSING.—The Candidate will be required to emboss, chase, and finish in metal as far as possible a design, showing the different stages and methods of working.

3. ENAMELLING.—A drawing to be engraved on metal, the pattern cut out as directed or made with cloison wire, and filled in with enamels, as a test of harmonious colouring, fired and polished.

4. ENGRAVING.—A drawing (heraldic or ornamental, to be engraved by Candidate, shading and details added to harmonize with general design.

(3.) **Specimen Work.**—Candidates are also required to submit one or more specimens of their work executed in the year preceding the examination.

The specimens of work must not exceed 6 ins. in any dimension, and must be accompanied by a working drawing or design by the Candidate himself. The work done at the Practical Examination, Section 2, together with the Specimen Work, must be forwarded, *carriage paid*, to London immediately after the Practical Examination. A certificate signed by the Candidate's employer or by the Class Teacher and a member of the School Committee, stating that the work has been executed by the Candidate himself, without assistance, *must be forwarded with the specimen*. In cases where the work has been executed at the Candidate's own residence, a Statutory Declaration will be required. Forms for either the Certificate or the Declaration may be obtained on application.

The Final Written Examination will be held on Wednesday, May 1st, from 7 to 10.

The Practical Examinations will be held on Wednesday, May 8th, and on Thursday, May 9th, from 7 to 10 p.m. each day, and at other times if found necessary.

The fee for the entire Examination is *Two Shillings and Sixpence*.

**II. Full Technological Certificate.**—For the Full Technological Certificate, the Candidate will be required to qualify as stated in Rules 29 and 30, but certificates showing he has passed the Examinations of the Board of Education in Geometrical Drawing, as well as in Freehand or Model Drawing, will be accepted in lieu of one of the science certificates.

**III. Works of Reference.**—"The Art of the Goldsmith and Jeweller," by T. B. Wigley (Griffin, London, 1898); Weale's "Goldsmiths' Handbook" (London, 1890); Hiorn's "Mixed Metals and Metallic Alloys" (London, 1890); Church's, "Precious Stones" (London, 1890); Bauer's "Precious Stones" (Griffin, 1903); "Gold and Silversmiths' Work," by J. Hungerford Pollen (Chapman & Hall); "Gold and Silversmiths' Work," by Henry Wilson (London, 1903); Cellini, "Treatise of Goldsmiths' Work," translated by C. R. Ashbee (London, 1898); "Art Enamelling on Metals," by H. H. Cunynghame (Constable, London, 1900); "The Decoration of Metals," by J. Harrison (Chapman & Hall, London, 1894).

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#### 45.—WATCH AND CLOCKMAKING.

The Examinations in this subject are intended both for those engaged (A) as watch and clock makers and repairers, and (B) in machine factories. In the examination in Grade I, which will

be of an elementary character, no distinction will be made between the two classes ; the questions will have reference mainly to general principles, and a considerable choice of questions will be given to Candidates. In the Final Written examination there will be three sections—a General Section and two distinct sections, A and B. The General Section will contain questions to be answered by all Candidates. Section A will contain questions connected with the principles of construction of hand-made watches, and complicated timekeepers, both watches and clocks, and will also be adapted to watch and clock repairers. Section B will have reference to the processes involved in the manufacture of watches on a large scale. A practical test forms part of the Final examination in both sections.

I. Syllabus.—The examination will include questions founded on such subjects as the following :—

#### GRADE I.

1. The various natural and conventional measures of time. The measurement of time by astronomical observations. Equation of time. Longitude.

2. Mechanical and physical principles which have a direct bearing on watch and clockmaking.

3. Functions of the different parts of a watch or clock, and the conditions which they must satisfy to secure efficiency.

4. Properties and uses of materials. Manipulation of the materials used in horology, *e.g.*, hardening, tempering, annealing, polishing, &c.

Cutting tools.

5. Friction. Lubrication. Capillarity. Design of pivots, and holes, &c.

6. Motive powers. Fusee. Maintaining powers. Stopworks. Keyless mechanisms.

7. Toothed gearing. Calculations relative to trains of wheels ; number of vibrations per unit time.

8. Classification, manner of action, and proportions of the escape-ments in common use, such as the recoil, dead-beat, pin-wheel, gravity, cylinder, lever, chronometer.

9. Fundamental principles in the theory of the pendulum. Simple calculations relative to length of pendulum and time of vibration.

10. Measuring instruments.

11. Description and use of various simple tools and appliances, such as—mandrils ; lathes ; rounding-up tools ; depth-tools, &c.

12. Practical methods of executing various pieces of work, either by hand or machine.

The fee for the examination in Grade I is *One Shilling*.

The Written Examination in both Grades will be held on Thursday, May 2nd, from 7 to 10.

## FINAL EXAMINATION.

### GENERAL SECTION.

(1.) Written Examination.—1. Simple astronomical problems relative to time, latitude and longitude, &c.

2. Toothed gearing : proof of necessary conditions for correct working ; selection and proof of suitable curves ; height of addenda ; effect of friction.

3. Elasticity : stress and strain ; the modulus ; the limit ; work done in bending ; shearing ; establishment of formulæ for bending, &c. Application to main and balance springs. Proof of formulæ relating to the barrel. Theory of the fusee.

4. Motion : straight and circular. Moments of inertia. Radii of gyration. Deviating force. Harmonic Motion. Application to pendulum and balance.

5. Theory of the compound pendulum. Conical pendulum. Pendulum errors.

6. Principle, construction, and calculation of all the dimensions of compensation pendulums. Methods of adjustment for temperature.

7. The balance and spring. The theory of timing. Damped harmonic motion. Effect of impulse and unlocking ; friction ; curb-pins ; lack of poise in moving parts, &c. Alteration in weight of balance and in dimensions of balance and spring ; length, breadth, thickness, and strain of springs. Theory of the terminal curves. Methods of adjustment for isochronism and positions.

8. The theory of the compensation balance. Secondary compensation. Adjustment for temperature.

9. Electric clocks. Non-magnetic watches.

### SECTION A.

Complicated clocks and watches. Striking work of clocks and watches. The less frequently used escapements, such as the duplex pin-pallet, &c. Hand manufacture of clocks and watches. Repairing clocks and watches.

## SECTION B.

Truth of surface ; the copying principle ; conversion of circular into reciprocating motion, and *vice versa* ; cams. Organisation of machine manufacture.

Tool-making : making punches, dies, drills, turning and milling cutters, grinders and polishers, &c.

Designing movements. Making the templates and standards. The various automatic or other machines and processes used in rolling, drawing, pressing, turning, drilling, milling, contouring, grinding, polishing, gilding, gear-cutting, screw-making, making the escapement material, making main and balance and other springs, balance-making, dial-making, hand-making, case-making, jewellery, making indexes, studs, bolts, banking-pins, barrel-arbors, stop-works, &c. Assembling and putting together the parts, springing, timing, and examining.

(2.) **Practical Test.**—The Practical Examination will consist of such ordinary work as will fairly test the handicraft and skill of a Watch or Clock maker.

The Examination may be held in any approved workshop for Watch or Clock makers, or in any school workshop containing the necessary bench and vice accommodation. Candidates will be expected to bring with them their own tools and material ; and in order that they may know what tools and material are required, full information as to the character of the Practical Test will be given to candidates at the time of the Written Examination.

The Practical Examination will be held on **Saturday, May 4th**, between 2.30 and 7.

After the Examination is over the Candidate's work must be carefully packed by a qualified Superintendent, and *at once* forwarded to the Department of Technology, Exhibition Road, S.W., carriage paid.

To obtain a Certificate, Candidates must pass in both parts of the Examination in the same year.

The fee for the entire Final Examination (Written and Practical) is *Two Shillings and Sixpence*.

**II. Full Technological Certificate.**—For the Full Technological Certificate, the Candidate will be required to qualify as stated in Rules 29 and 30.

**III. Works of Reference.**—Saunier's "Treatise on Modern Horology" (Crosby Lockwood & Son, London) ; Sir E. Beckett "Clocks, Watches, and Bells" (Crosby Lockwood & Son) ; "Horological Journal" ; "An Essay on the Detached Lever Escapement," by M. Grossmann ; Saunier's "Watchmakers' Handbook" (Crosby Lockwood & Son) ; "Revue Chronométrique" ; "Journal Suisse d'Horlogerie" ; "The Watchmaker, Jeweller, and Silversmith" ;



"Watch and Clockmakers' Handbook, Dictionary, and Guide," by F. J. Britten; "Old Clocks and Watches," by F. J. Britten (Batsford); "Watch and Clock Making," by D. Glasgow (Cassell); "The Theory of Timing," by L. Lossier; "Watch Springing and Adjusting," by Britten (E. and F. N. Spon); "Watch Repairing," by F. J. Garrard; "Friction, Lubrication and the Lubricants in Horology," by W. T. Lewis; "A Practical Treatise on Gearing," by Browne and Sharpe; "Lessons in Horology" by J. & H. Grossmann (Keystone Press); "Practical course in adjusting" by Theo. Gribi (Jewellers Circular Publishing Co.); "Théorie du réglage," by E. James; "Théorie des sonneries," by E. James; "Concours national de compensation des chronomètres pour les températures," by G. Cellérier; "L'électricité et ses applications à la Chronométrie," by A. Favarger; "L'échappement à ancre," by L. A. Grosclaude; "Les fabriques américaines d'Horlogerie et leur outillage," by Ch. Houriet; "Établissage et repassage des Montres à Répétition," by J. Huguenin; "Manuel de l'Horloger Praticien"; "Étude de l'échappement à ancre," by J. Natermann; "Enseignement théorique de l'Horlogerie," by J. Rambal; "Instructions pratiques sur la tenue d'une feuille de réglage," by J. Rambal; "Dix tableaux pour déterminer la grandeur des roues et pignons d'Horlogerie," by H. Schouffelberger; "Système des vis horlogères," by Thury; "Les nouveaux alliages acier-nickel," by Dr. Ch. Ed. Guillaume.

#### 46.—MECHANICAL ENGINEERING.

The Examinations will be held in three Grades. Candidates will be permitted to present themselves for the Examination in Grade I in a year either previous or subsequent to that in which they present themselves for Examination in Grade II, or to enter for both Grade I and Grade II in the same year. No Candidate will, however, receive a Certificate until he shall have passed the Examinations in both grades. The successes of Candidates in either grade will be notified to the Secretaries of the Centres at which they were examined.

Prizes will be awarded on the results of the Examination in Grade II to those Candidates only who have passed Grade I in a previous year, or who passed both grades in the same year.

Candidates for the Final Examination must hold a Certificate in Grade II.

Candidates should bring to the Examinations Tables of Logarithms, drawing instruments, and slide rules.

##### I. Syllabus.

##### GRADE I.

The Examination in Grade I is intended to be preliminary to that in Grade II, and will not necessarily involve any knowledge which can only be obtained by work in an Engineering Laboratory. The

questions will be simple, and will be founded on subjects which may be taught in an Evening Class.

Candidates will be examined in *two* only of the following four divisions, but it is recommended that the course of instruction should in all cases include the subjects of division (B.) :—

(A.) Tracing the path of points in the links of given mechanisms geometrically. Transmission of motion by belts, ropes, and toothed gearing. Simple mechanisms, such as toggle joint, parallel motions, cam arrangements, crank and connecting rod. Application of the principle of work to mechanisms; velocity ratio; force ratio; drawing of velocity and force curves.

(B.) Elementary relations of stress and strain. The strength of materials to resist tension, compression, shearing, torsion, and bending. Application of the rules of the strength of materials to the design of the simpler machine elements.

(C.) Combustion of fuel and the generation of steam. Elementary theory of the action and construction of steam-engines, internal combustion engines and boilers. Indicator diagrams; flywheels; governors; the simplest forms of valves and valve gears.

(D.) Classification of Pig Iron. Grading. Cupola charges for different varieties of iron. Influence of carbon, silicon, and other impurities on the properties of iron. Chilled and malleable iron castings: quality of iron for producing them and changes which take place in the chilled mould, and in the production of malleable castings. Composition of alloys: waste in mixing alloys. Physics of cast iron, cast steel, and other alloys. Shrinkage. Crystallization. The casting of test-pieces and the methods of testing them. Calculation of the breaking stress. The weight of castings and patterns. Fluid pressure. Welding, annealing. Chain testing. Testing of welds. Strength of chains, tension elements, struts and simple beams. Principle of the lever. Lifting power of cranes, winches, and pulley blocks. The timbers used in pattern making: shrinkage of timbers; lateral and longitudinal strength of timbers. Practical methods of setting out the profiles of wheel teeth. The triangle of forces and its applications to determine the forces in the members of simple structures.

The Examination in Grade I will be held on Tuesday, April 30th, from 7 to 10. The fee for the Examination is *One Shilling*.

## GRADE II.

Candidates passing the examination in Grade II will not receive certificates unless or until they shall have passed in Grade I also. See page 202.

The Examination in Grade II is intended to test the Candidate's practical knowledge of some *one* branch of Mechanical Engineering, as acquired in an engineer's shop.

Candidates will be examined in *one only* of the following five branches.

(A.) *Machine Drawing and Designing*.—In this section of the Examination the Candidate will be allowed the use of any one pocket-book or treatise on machine designing he may choose to bring with him, but he must state the title of the pocket-book or treatise used.

Exercises will be given in drawing simple machine and engine details, and questions will be asked with reference to points of design in the exercise given.

(B.) *Pattern Making*.—Principles and practice of pattern making. Timbers used by pattern makers. Wood working tools. Building up patterns. Core prints and core boxes. Contraction of castings. Strickling boards. Iron patterns. Patterns for plate moulding. Principles of ventilating moulds. Principles of sand and loam moulding.

(C.) *Foundry Work*.—Principles of moulding. Moulding sands and loam. Methods of moulding in various materials. Moulding machines. Moulding machines for spur gearing. Core making and drying. Parting surfaces, gates, vents, risers, chills, and chilled castings. Cupolas and crucible furnaces. Foundry mixtures. Ladles. Brass-founding and brass furnaces.

(D.) *Fitters' Work*.—Chipping, filing, turning, drilling, shaping, and milling. The grinding and tempering of tools. Cutting speeds. Calculation of change wheels and pulley sizes. Use of measuring instruments, gauges and scribing blocks. Use of surface plates, squares, and levels. Construction and use of vices, machine vices, and the simpler chucks. Simple engineering workshop appliances.

(E.) *Smiths' Work*.—Smithing, forging. Construction of forge. Forging and smithing tools. Blowers. Steam hammers. Forging from dies. Forging from the solid. Welding. Examples of simple cases of forging and welding. Fluxes. Hardening and tempering of tools. Annealing and case-hardening. Method of forging a double throw crank shaft. Welding chains.

NOTE.—Candidates selecting Branch B., C., D., or E., will be required to do a simple piece of Machine Drawing in addition to the written paper in the selected division. The use of pocket-books or treatises on machine designing is not allowed to Candidates in these sections.

All Candidates will require a drawing board, T-square, and drawing instruments. Drawing paper is provided by the Institute.

Hand sketches should be used to illustrate the answers; but no credit will be given for these unless they are fairly well drawn and

well proportioned, or unless construction is shown by dotting and sectional shading.

The Examination in Grade II will be held on **Thursday, May 2nd**, from 7 to 10 p.m. The fee for the Examination is *One Shilling and Sixpence*.

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### FINAL EXAMINATION.

*Candidates for the Final Examination must hold a certificate in Grade II.*

To obtain a certificate on the results of the Final Examination the Candidate must pass a Written and a Practical Examination, to be taken in the same year.

(1.) **Written Examination.**—In the Written Examination on **THE MECHANICS OF ENGINEERING**, candidates must select questions from not more than *two* of the following three divisions:—

(A.) The elasticity and strength of materials, including the more practical and elementary problems in compound stress. Tension, compression, and torsion. Combined bending and torsion. Combined thrust and bending. Riveted joints and the design of riveted work. Collapse. Behaviour of materials when tested. Ordinary limits of working stress.

(B.) The theory of the steam engine, including the thermodynamics of the action of steam. The solution of problems relating to the simpler valve gears. Governors and fly-wheels. The theory of gas engines, oil engines, hot air engines, air compressors and refrigerating machines.

(C.) Hydraulics and hydraulic motors. Theory of flow from orifices. Flow in pipes. Water wheels, turbines, and pumps. Construction and action of valves. Governors for hydraulic machinery. Hydraulic transmission of power. Hydraulic pressure engines. Lifts.

The Written Examination will be held on **Thursday, May 2nd**, from 7 to 10 p.m.

(2.) **Practical Examination.**—Candidates will be examined in one division only, either in *A—Machine Designing*; or *B—Workshop Practice*.

*A.—Machine Designing.*—Data for a design in Mechanical Engineering will be forwarded to the School Secretary, on or before April 13th. The design to be worked out and drawn, and the drawings and a reasoned description of the design, with a summary

of calculations of strength, &c., to be returned not later than May 15th.

A certificate signed by the Candidate's employer or by the Class Teacher and a Member of the School Committee, stating that the work has been executed by the Candidate himself without assistance, *must be forwarded with the drawing*. In cases where the work has been executed at the Candidate's own residence, a Statutory Declaration will be required. Forms for either the Certificate or the Declaration may be obtained on application.

*B.—Workshop Practice.*—For Candidates selecting this branch of practical work, simple castings or forgings will be sent, with dimensioned sketches of the forms to which they are to be worked, by chipping, filing, turning, or screw-cutting. Candidates may be examined in (a) Fitters' Work; (b) Turning; or (c) Pattern-making; and it must be stated on the application form which section they select. A Certificate signed by the Candidate's employer or shop foreman or by the Class Teacher and a Member of the School Committee, stating that the work has been executed by the Candidate himself without assistance, *must be forwarded with the specimen*. In cases where the work has been executed at the Candidate's own residence, a Statutory Declaration will be required. Forms for either the Certificate or the Declaration may be obtained on application. A Candidate may produce, in addition to the exercises set, one piece of work chosen by himself; but he must state the date when it was executed, and the time occupied.

The material and instructions will be sent on or before April 13th and the work must be returned, *carriage paid*, to London not later than May 22nd.

In the Final Examination great care should be taken that sketches and drawings are workmanlike and show real knowledge of proportion and construction.

The fee for the entire Final Examination (Written and Practical) is *Three Shillings and Sixpence*.

**II. Full Technological Certificate.**—For the Full Technological Certificate the candidate will be required to qualify as stated in Rules 29 and 30.

**III. Works of Reference.**—Low & Bevis "Manual of Machine Drawing and Design" (Longmans); R. H. Smith's "Cutting Tools"; Hasluck's "Metal Turners' Handbook"; Shelley's "Workshop Appliances"; Compton's "First Lessons in Metal Turning"; Northcott's "Lathes and Turning"; Horner's "Principles of Fitting" (Whittaker & Co.); Perry's "Applied Mechanics"; Cotterill's "Applied Mechanics" (Macmillan); Blaine's "Hydraulic Machinery"; Cotterill's "Steam Engine"; Ripper's "Steam Engine"; Seaton's "Manual of Marine Engineering" (Griffin); Sennett and Oram's "Marine Steam Engine" (Longmans); Wilson's "Steam Boilers"; Donkin,

"The Heat Efficiency of Steam Boilers" (Griffin & Co.); Robinson's "Gas and Petroleum Engines"; Unwin's "Machine Design"; Kennedy's "Mechanics of Machinery"; Adams' "Handbook for Mechanical Engineers"; Moray and Biggs' "Mechanical Engineering"; "The Steam Engine," by Prof. Ewing; Article, "Hydraulics" ("Encyclopædia Britannica," published separately); Marks' "Hydraulic Machinery"; "Mechanical Engineering," by W. S. Lineham (Chapman & Hall); "The Gas Engine," by D. Clerk; "Strength of Materials," by Prof. Ewing; "The Balancing of Engines" by W. E. Dalby (Arnold); "Strength and Elasticity of Structural Members," by R. T. Woods (Arnold); "Mechanism," by S. Dunkerley (Longmans); "Machine Tools and Workshop Practice," by A. Parr (Longmans); "Valves and Valve Gears Mechanism," by W. E. Dalby (Arnold); "Hydraulics," by F. C. Lea (Arnold); "Pattern Making," by Horner (Whitaker & Co.); "Pattern Making," by H. Aughtie (Scientific Publishing Co.); "Practical Ironfounding," by Horner (Whitaker & Co.).

#### 47.—ROAD CARRIAGE BUILDING INCLUDING MOTOR CAR BODY WORK.

This syllabus is drafted on the assumption that an apprentice in his third year ought to be able to pass in the Second Class of Grade II, and in his last year he ought to pass in the First Class. A general foreman and a shop foreman respectively should be able to pass in the First and Second Class of the Final Examination.

The Examination in Grade I will be a written examination only, but simple drawings will be required.

In the Final Examination; (1) Specimens of work must be submitted by the Candidates before the Examination; (2) The Written Examination may include questions with regard to any type of carriage or motor car body, and drawings will be required to illustrate the answers to some of the questions; (3) A special drawing and specification, &c., relating thereto will be required to be done, after the Written Examination, in the Candidate's own time but completed by a given date.

At the Written Examination in either grade, drawing paper will be provided by the Institute, but Candidates must bring their own drawing instruments. *No curves or patterns will be allowed.*

#### I. Syllabus.—

##### GRADE I.

The Course of Instruction in this grade should in general cover two years: the Examination questions will be founded on the following subjects:—

1. Timber used in Coach Building and Motor Body work, and the purpose for which each kind is best suited. Measuring and

valuing timber, natural and artificial seasoning, and the use of bent timber.

2. Iron and steel : the process of forging and welding ; how to tell the quality of steel and iron ; special precautions required when forging or tempering various kinds of iron and steel. Aluminium and other metals used for panels, wings, &c.

3. Designing and drawing side view and plan and back view of carts, wagonettes, Landaus, Victorias, Broughams, and other carriages, *open or closed*, and motor bodies. Designing and drawing joints used in coach making.

4. Sizes of poles, bars, and shafts for various horses or ponies ; position of tug stops and staples, &c. Varieties of under-carriages.

5. Wheels with wooden spokes, including artillery patterns ; sections of hubs, spokes and tyres, channels, pneumatic tyres. &c.

6. Sizes and shapes of axles and springs and motor axles. Spring making and methods of testing springs and axles, setting them true, and fixing. Shock absorbers.

7. Ironwork on bodies and carriages. Lever brakes, foot brakes, wind screen, ironwork for luggage, tyre carriers, grids, &c.

8. Painting : materials used and process of painting and varnishing. Preparation of paint from crude or dry colour, properties of the oils, varnishes, and other materials used.

9. Trimming materials : leather, cloth, lace, &c. Methods of sewing, stuffing, &c. Marking out materials, especially with a view to appearance and economy.

10. Tools used by wood workers, smiths, painters and trimmers, and the common workshop appliances and machinery.

The Written Examination in both Grades will be held on Thursday, May 2nd, 7 to 10 p.m. The fee for the entire Examination in Grade I is *One Shilling and Sixpence*, and for the Final Examination *Two Shillings and Sixpence*.

#### FINAL EXAMINATION.

(1.) **Written Examination.**—In the Final Examination more difficult questions will be set in the above subjects, and the questions may apply to any kinds of carriage or motor car body ; some knowledge will also be required of :—

1. Designing and drawing any carriage, including C-spring perch carriages, and the best class of motor bodies, either to the English or to the French metric scale.

Making working drawings for use in the shops, such as drawings of iron work, sections of framing and of naves. Calculating the

sizes of wheels, springs, axles, and the quantity of timber, leather and other materials required; cutting out patterns. Writing out workshop orders.

2. Specifying the work to be done to a carriage or motor car when worn or damaged. The remedying of defects, such as noise or vibration.

3. Methods of overcoming difficulties of construction, as in making folding hoods and seats, movable canopies and Brougham tops, Landaulette pillars and door tops.

4. Tensile and crushing strength of iron, steel, timber, aluminium, &c. Calculation of safe load on springs, wheels, framework, &c. Best method of arranging the material so as to secure the greatest strength and least weight that is practicable. Calculation of stresses and position of greatest stress. How to remedy faults of construction, so as to strengthen a body or the frame of chassis if it is too weak.

5. How to test the quality of the various materials used—iron, leather, cloth and waterproof materials, paint, &c.

6. Machinery used in Coachmaking.

(2.) **Drawing.**—Candidates for the Final Examination will be required to prepare a design, the data for which will be given at the time of the Written Examination. The design to be worked out and drawn, and the drawings, with description, calculations, &c., to be returned to the Offices of the Department not later than Wednesday, May 22nd. A Certificate signed by the Candidate's employer or by the Class Teacher and a Member of the School Committee, stating that the work has been executed by the Candidate himself, without assistance, *must be forwarded with the Drawing*. In cases where the work has been executed at the Candidate's own residence, a Statutory Declaration will be required. Forms for either the Certificate or the Declaration may be obtained on application. Candidates, in addition to the ordinary mathematical instruments, may use wooden patterns.

(3.) **Specimen Work.**—Every Candidate will be required to forward not later than April 29th a specimen of work executed during the twelve months preceding the Examination. A Body Maker (carriage or motor) will be expected to send in a specimen of *woodwork* (for example, one or more joints used in Body Making; such work not to be glued up but loosely wedged together so as to be easily taken apart for inspection); a Painter should forward a small portion of a finished panel; a Draughtsman should forward drawings; and a Candidate engaged in the Office should send in a specimen of detailed costing as applied to the manufacture or repair of a carriage or motor.

The specimen of work should not in any case exceed a cubic foot in dimensions. It must be accompanied by a Certificate or Declaration as required for the Drawing executed under (2).



**II. Full Technological Certificate.**—For the Full Technological Certificate, the Candidate will be required to qualify as stated in Rules 29 and 30, but Certificates showing that he has passed the Examinations of the Board of Education in Geometrical Drawing, as well as in Freehand or Model Drawing, will be accepted in lieu of one of the Science Certificates.

**III. Works of Reference.**—"The Coachbuilders' Art Journal"; "Treatise on Coach Painting," by W. Simpson; "Handbook on Coach Trimming," by Middleton; "Papers read before the Institute of British Carriage Manufacturers"; "Coach Trimming," by W. Farr and G. A. Thrupp; "Noises found in Carriages"; "History of the Art of Coachbuilding" (All the above published by J. and C. Cooper, 64, Long Acre, London, W.C.); "Wheel Making," by J. S. Foggett (Kemp); "The Draught of Carriages" (Kemp); "Body-Making," by Mattison (Bittern, Southampton); "Art and Craft of Coachbuilding," by Philipson (Bell); "Suspension of Carriages," by W. Philipson (Hub Publishing Co., New York); "The Automobile and Carriage Builders' Journal" (16, Eldon Street); "The Autocar" (20, Tudor Street); "The Motor Car Journal" (27, Charing Cross Road).

## 48.—RAIL CARRIAGE BUILDING.

**I. Syllabus.**—The Examination will include drawing and questions founded on such subjects as the following:—

### GRADE I.

(1.) **Written Examination.**—Questions will be set on the following:—

1. The nature and properties of the materials used in building rail carriages, wagons and tram cars, such as timber, iron, steel, brass, cloth, leather, paint, &c.

2. Drawing to scale, and sketching as applied to details of rolling stock.

3. The preparation of materials, and the mode of conversion by machine and other tools, to avoid waste and to increase economy.

4. Carriage painting, decorating, varnishing and trimming.

(2.) **Drawing.**—Candidates in Grade I will be required to make a simple scale drawing of a carriage, or parts of a carriage, for which purpose the use of ordinary mathematical instruments, including a scale rule and squares, but no patterns, will be allowed.

*Drawing paper is provided by the Institute, but all necessary instruments must be provided by the Candidates or the School.*

The Written and Drawing Examination in Grade I and the Final Written Examination will be held on Thursday, May 2nd, from 7 to 10 p.m. : the Final Drawing Examination will be held on Saturday, May 4th, from 2.30 to 6.30 p.m. The fee for the Written and Drawing Examination in Grade I is *One Shilling and Sixpence*, and for the Final Examination *Two Shillings and Sixpence*.

#### FINAL EXAMINATION.

(1.) **Written Examination.**—In the Final Examination more difficult questions will be set in the above subjects, and, in addition a knowledge will be required of :—

1. The machinery used for the conversion of materials, the speed and form of cutting edges for planing, moulding, mortising, sawing, &c. Smithy tools for stamping, forging, bending, &c. Appliances for moulding and casting metals.

2. Designing, with regard to form, carrying capacity, safe and easy working of passenger and goods vehicles. Brake gear, ventilation, heating, lighting, inside accommodation, &c., for English, Colonial and foreign rolling stock.

3. The methods of felling, storing and seasoning timber, and the procuring from abroad woods suitable for rail carriage building.

4. Workshop processes for the construction of the different parts of rolling stock.

5. Identification of specimens of wood used in Railway Carriage Building.

6. Design, construction and laying out of Railway Carriage work

(2.) **Drawing.**—Skeleton drawings or sketches of parts of carriages or wagons or details used in the construction of such vehicles will be supplied, and the Candidate will be required to make drawings from them, filling in the details and making such sections as may be asked for, together with any necessary calculations. At the Written Examination Candidates will be furnished in general terms with particulars of alternative subjects with which the drawings to be set at this Examination will be connected.

Candidates may use ordinary mathematical instruments.

**II. Full Technological Certificate.**—For the Full Technological Certificate, the Candidate will be required to qualify as stated in Rules 29 and 30, but Certificates showing that he has passed the Examination of the Board of Education in Geometrical Drawing, as well as in Freehand or Model Drawing, will be accepted in lieu of one of the Science Certificates.

III. Works of Reference.—“Handbook for Coach Painters,” by William Simpson (Cooper Bros. & Attwood); “Coach Trimming,” by W. Farr and G. A. Thrupp (Chapman & Hall); “Railway Machinery and Rolling Stock,” by D. K. Clarke (Blackie & Sons); “Car Builders’ Dictionary,” by M. A. Forney, 73, Broadway, New York; “Railway Car Construction,” by William Voss (New York); “Painters’ Colours, Oils and Varnishes,” by Hurst (Griffin); “Wood Conversion by Machinery,” by T. Richards (Spon); “Sawmill Machinery,” by Powis Bale (Crosby Lockwood & Co.); “Railway Carriages and Waggon: Design and Construction,” by Sidney Stone (3, Ludgate Circus Buildings); “Railway Gazette” (73, Broadway, New York); “Railway Engineer,” “The Railway Age,” “Engineering,” “The Engineer,” “Engineering Review,” “Railroad Car Journal” (New York); “The Tramway and Railway World” (London); “The Railway Magazine” (London).

#### 49.—TYPOGRAPHY.

With the view to encouraging Apprentices to take a continuous Course of Instruction in this Subject, the Examinations will be held in three Grades, of which Grade I will be of an elementary character. No Certificates will be given on the results of the Examination in Grade I, but the list of the names of the Candidates who pass will be sent to the Centre at which they were examined. Candidates may enter for the Examination in Grade II without having passed in Grade I, but Candidates for the Final Examination will be required to have previously passed in Grade II.

In addition to the Money Prizes and Medals offered by the Institute (see p. 340), Prizes of £1 are awarded by the Printers’ Managers and Overseers Association to the winners of the First Prizes at the Final Examination and in each section of Grade II, and Prizes of 5s. to the winners of the Second Prizes in each section of Grade II.

With a view to encourage Apprentices to pursue their studies at a Technical School, whether the apprentices are regularly indentured or not, provided they are under 21 years of age and have been working as learners at the Printing Trade for a period of at least two years, the Worshipful Company of Stationers offer Prizes of Four Guineas and Two Guineas with a Silver Medal in each case to the two candidates respectively who obtain the highest number of marks in the First Class of Grade II of the Institute’s Examination in Typography, including Compositors’ Work. In the award of these Prizes, preference will be given to Apprentices working or residing within a radius of 20 miles of Stationers’ Hall, Ludgate Hill, E.C. Candidates who succeed in obtaining either of the Stationers’ Company’s Prizes will not be also eligible for the Institute’s Prizes of £2 and £1, which are awarded to qualified candidates in each section of the Typography Examination.

I. Syllabus.—

GRADE I.

The Examination in Grade I will consist of a Paper of Questions only in two Sections, (1) for Compositors, and (2) for Press and Machine Candidates, but Candidates for either section will be expected to show some knowledge of Elementary Geometry and Freehand Drawing. The Examination will include such subjects as the following:—

1. *Composing*.—Spelling ; punctuation ; appliances and materials used in case room ; technical terms generally ; composition of type metal ; qualities of good type ; description of the parts of a type ; weight of type and leads ; relationship of type bodies and their proportion to foot ; lays of the case ; characters in a fount ; casing letter ; attitude at frame ; rules to remember when setting ; habits to acquire and avoid ; rules for spacing and justifying ; rules for dividing words ; rules for distributing ; locking-up and unlocking ; casting up matter ; readers' marks ; signatures and their use ; definition of stereo, electro, woodcut, and process blocks.

2. *Press and Machine Work*.—Sizes and sub-divisions of papers and cards ; number of sheets in quires and reams ; use of signatures ; chases and furniture ; locking-up and unlocking formes ; simple schemes of imposition ; definitions of stereotype, electrotpe, woodcut, process block, three-colour process ; other technical trade terms and phrases ; descriptions of hand-presses, platen and single cylinder machines ; how to cover a tympan, cut out a frisket, prepare a platen for making-ready, and dress a cylinder ; the constituent parts and working condition of rollers ; the care of inks ; washing of formes ; cleansing of wood, electro, and process blocks ; mounting plates.

The Examination in Grade I will be held on Monday, April 29th, from 7 to 10. The fee for the Examination is *One Shilling*.

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GRADE II.

The Examination in Grade II will consist of a Paper of Questions, and of a Practical Examination for Compositors to be held in a Printing Office. Candidates who enter under Section I must pass in both parts of the Examination to obtain a Certificate.

(1.) *Written Examination*.—The Examination will be divided into two parts, (1) for Compositors, and (2) for Pressmen or Machine Minders. Candidates, according to their occupation, may select their questions from Section I. or from Section II.

The questions will be founded on such subjects as the following:—

I. *Composing*.—All the matter contained in the Syllabus for Grade I ; production of book-work ; casting off MS. ; preliminary

matter—how to set; notes—how to set; making up—various operations; proportions of type to page; measures for book-work; making margin; imposition; sheet and half-sheet work; signatures; various problems in type bodies; point system; display in its various phases; use of ornament in display; use of borders and vignettes, &c.; classification of job-work; harmony of colour; composition of colour work; tint blocks; sketching (rough); table work—how to set; paper—machine and hand-made, various subdivisions, qualities and weights, equivalent weights.

II. *Press and Machine Work.*—Paper—machine and hand-made; qualities of paper; super-calendered and enamelled paper; uses of wet and dry paper; damping of paper and preparing it for working; folding, stitching, stabbing, and sewing; counting, packing, and keeping stock; sizes of jobs; schemes of imposition; methods of drying printed work; hot and cold pressing; hot and cold rolling; embossing; quoins and their application; the principal working parts of the various hand-presses, platen, cylinder, and perfecting machines; making ready jobs and bookwork on same; making register; use of points; the composition and casting of rollers; ink—medium and quick drying; coloured ink; suitable ink for certain papers; underlaying and overlaying; hard packing system in making-ready—when best employed; preparing overlays for woodcuts and process blocks; imposing stereotype plates for press or machine; varieties of mounting blocks and methods of mounting in use; printing with bronze and leaf metal; causes of slurring on press or machine; electrotyping; stereotyping; composition of ink; harmony of colour; rules for the selection of two, three, and four-colour combinations; mixing colours; three-colour printing; process blocks, their manufacture and preservation.

The Written Examination will be held on Tuesday, April 30th, from 7 to 10 p.m.

(2.) **Practical Examination.** (For Compositors.)—The Practical Examination will consist mainly of composition from manuscript or printed copy supplied to the Candidate. It is intended to be a test, not so much of mere rapidity in “picking-up,” as of general intelligence and of ability in setting any kind of matter that may fall in a Compositor’s way, clean setting and good spacing being important; for instance, a piece of bad manuscript, a simply displayed title-page or job, a difficult piece of punctuation, a moderately complex table, classical phrases or proper names, or a foreign paragraph in fairly good hand-writing. The Practical Test will take place at different centres throughout the country, at which the necessary arrangements can be made. The Examination will be conducted, as far as possible, under the superintendence of expert assistants, who will be required to report to the Chief Examiners as to the manner in which the Candidates have set about the several exercises given to them.

The Practical Examination for Compositors will be held on Saturday, April 27th, from 2.30 to 7.

The fee for Compositors (including both Written and Practical Examinations) will be *Three Shillings and Sixpence*, for Machine Candidates who take the Written Examination only *One Shilling and Sixpence*.

#### FINAL EXAMINATION.

*Candidates for the Final Examination must hold a Certificate in Grade II.*

The questions will not be limited to any particular Syllabus, but will be based upon the groundwork of the Syllabuses for the previous Grades, with a wide range of the whole subject of Letterpress Printing, and will include such subjects as the following:—

Construction and management of the hand-press and of platen, cylinder, perfecting, and rotary machines; making-ready; rollers—their manufacture and treatment; the processes of stereotyping and electrotyping; process blocks—line and half-tone: their production and suitability for various classes of work; inks—black and coloured: treatment of; three-colour work; composing and distributing machines; power—steam, gas, and electric; shafting and gearing; the principles of estimating; charging up work; the various essentials required for the production of a perfectly printed book; book-keeping for printers; general management; the warehouse; cost generally of plant, material, paper, &c.

The Final Examination will be held on Tuesday, April 30th, from 7 to 10 p.m. The fee for the Examination is *One Shilling and Sixpence*.

**II. Full Technological Certificate.**—For the Full Technological Certificate, the Candidate will be required to qualify as stated in Rules 29 and 30, but Certificates showing that he has passed the Examinations of the Board of Education in Geometrical Drawing, as well as in Freehand or Model Drawing, will be accepted in lieu of one of the Science Certificates.

**III. Works of Reference.**—*Letterpress printing* — “Practical Printing,” J. Southward and A. Powell, 5th edition, 2 vols., 1900 (Powell, 62, Fleet Street, 11s. 6d.). “Modern Printing,” J. Southward, 1898–99, 4 vols. (Raithby, Lawrence & Co., Leicester, 3s. 6d. per vol.). “Fine Printing,” Geo. Joyner, 1895 (Cheap edition, Raithby, Lawrence & Co., 2s. 6d.). “Printing: A Practical Treatise,” C. T. Jacobi, 1904 (Bell & Sons, 7s. 6d.). “Printers’ Handbook of Trade Recipes,” C. T. Jacobi, 1905 (C. T. Jacobi, 5s. net). “Printer’s Primer,” J. Southward, 1895 (Powell, 1s.). “A Practical Manual of Typography,” A. Oldfield, 1890 (Menken,

3s. 6d. net.). *Machine work*—"Presswork," W. J. Kelly, 1894 (Raithby, Lawrence & Co., 6s.). "Principles and Progress of Printing Machinery," J. F. Wilson and J. Southward (Menken, 5s.). *Composing machines*—"How to Become a Successful Linotype Operator," E. T. Thomlinson, 1900 (Linotype Users' Association, 1s.). *Estimating*—"The Ideal Price List, Estimating Guide, and Cost Book," T. L. Whitehead, 1901 (Raithby, Lawrence & Co., 3s. 9d.). "Estimating, Bookkeeping, System for Letterpress and Lithographic Printers, Binders and Stationers," J. B. Gotts, 1901 (The Author, 46, Chandos Road, W., New Town, Stratford, E., 3s. 6d.). "Prices for Pamphlet Printing," T. L. Whitehead (The Author, 75, Walmersley Road, Bury, Lancs., 1s. 6d.). *Stereotyping and Electrotyping*—"Practical Notes on Stereotyping and Electrotyping," 1901 (Raithby, Lawrence & Co., 3s. 6d.). "Stereotyping and Electrotyping," F. J. Wilson, 1898 (Menken, 5s.). *Lithography*—"Grammar of Lithography," W. D. Richmond, c. 1894 (Menken, 5s.). "Colour and Colour Printing as applied to Lithography," W. D. Richmond, c. 1894 (Menken, 5s.). "Zincography," J. Bock, c. 1892 (Menken, 2s. 6d.). "Photo-lithography," G. Fritz, 1895 (Dawbarn & Ward, 5s.). "Collotype and Photo-lithography," J. Schnauss, 1894 (Iliffe & Son, 5s.). "Manufacture of Varnishes, Oil Crushing, Refining and Boiling," Livache and McIntosh, 1899 (Scott, Greenwood & Co., 12s. 6d.). "Treatise on Photogravure," H. Denison, c. 1894 (Iliffe & Son, 4s. 6d.). *Process work*—"Practical Half-tone and Tri-colour Engraving," A. C. Austin, 1898 (McCoy, 8s. 8d.). "Half-tone Process," J. Verfasser, 1895 (Percy Lund & Co., 2s. 6d.). "Photographic-Reproduction Processes," P. C. Duchochois, 1892 (Hampton, Judd & Co., 5s.). *Colour*—"Science of Colour Mixing," D. Paterson, 1900 (Scott, Greenwood & Co., 7s. 6d.). "Colour: A Handbook of the Theory of Colour," G. H. Hurst, 1900 (Scott, Greenwood & Co., 7s. 6d.). "Dictionary of Chemicals and Raw Products used in the Manufacture of Colours, Varnishes, etc.," G. H. Hurst, 1901 (Scott, Greenwood & Co., 7s. 6d.). "Painters' Colours, Oils and Varnishes," G. H. Hurst, 1896 (Griffin & Co., Ltd., 12s. 6d.). *Paper*—"Practical Paper-making," G. Clapperton, 1894 (Marchant Singer & Co., 5s. 4d.). "Treatise on Paper," R. Parkinson, 1896 (Marchant Singer & Co., 3s. 9d.). *Miscellaneous*—"Spelling and Punctuation," H. Beadnell, 1894 (Menken, 2s. 6d.). "Stops, or How to Punctuate," P. Allardyce, 1902 (T. Fisher Unwin, 1s.). "Proof-reading," F. H. Teall, 1899 (Raithby, Lawrence & Co., 4s. 6d.). "Ink Manufacture," by S. Lehner, 1902 (Scott, Greenwood & Co.).

## 50.—LITHOGRAPHY AND ALLIED PRINTING PROCESSES.

The course of instruction is intended to cover at least three years. Each year's work is indicated in the following syllabuses, which form a continuous and progressive course of study, and also define the subjects upon which the Examination questions will be founded.

In addition to the Money Prizes offered by the Cordwainers' Company and the Medals awarded by the Institute (see p. 335) the Printers' Managers and Overseers Association offers a Prize of £1 to the winner of the First Prize at the Final Examination and a Prize of 10s. to the winner of the First Prize at the Examination in Grade II.

With a view to encourage apprentices to continue their studies at a Technical School, whether such apprentices are regularly indentured or not, provided they are under 21 years of age and have been working as learners at the Trade for a period of at least two years, the Worshipful Company of Stationers offer a Prize of Three Guineas and a Silver Medal to the apprentice or learner who passes the Institute's Examination in the First Class of Grade II and obtains the highest number of marks among qualified candidates. In the award of this Prize, preference will be given to candidates working or residing within a radius of 20 miles of Stationers' Hall

### I. Syllabus.—

#### GRADE I.

The examination in Grade I will be adapted to the standard of apprentices; candidates for examination will be expected to possess a knowledge of practical processes and an elementary knowledge of the principles on which they are based in accordance with the following syllabus :—

1. LITHOGRAPHIC STONE.—Elementary knowledge of the composition and physical nature of the litho stone. The various hand-methods of preparing litho stones for transferring and drawing upon—grinding, polishing, graining. Also their preparation by chemical methods, such as stone-cleaning fluids.

2. LITHOGRAPHIC PLATES.—Re-cleaning and re-graining of zinc and aluminium plates by hand methods.

3. MATERIALS.—Nature and use of the materials commonly used in Lithography, such as tallow, gum arabic, acids, French chalk, resins, varnishes, wax, shellac, cuttle fish, turps, caustic soda and potash, soap, paraffin and the oils employed in lithographic printing.

4. PAPERS.—Machine made uncoated printing papers: their nature and qualities; dimensions of the more common printing papers, tinted and white, wove and laid, sized and unsized.

5. LITHOGRAPHIC PRINTING INKS.—Nature and properties of simple pigments, such as black, vermilion, bronze blue, chrome yellow. Simple colour mixing. Driers, their action on ink and printing surfaces.

6. PRESSES.—The lithographic hand-press and its various tympan of metal and leather, and their treatment. The copper plate press.



7. **HAND-PRESS ROLLERS.**—Their structure and coverings. Breaking in new rollers.

8. **TRANSFERRING.**—The essential principles in transferring. Advantages of warm and cold stones. Transferring autographic circulars. Transferring commercial work for hand-press and for machine printing. Making up or imposition of transfers. The pulling of copper and steel plate transfers. The composition of stone to stone and plate to stone transfer inks and transfer papers.

9. **DOCTORING** feeble work, and other restorative methods.

10. **BRONZING.**—Bronzing by various hand methods.

11. **TRANSPOSING** designs from black to white by simple methods.

The Examination in Grade I will be held on Monday, April 29th, from 7 to 10 p.m. The fee for the Examination is *One Shilling*.

No Certificates will be given on the results of the Examination in Grade I, but the Candidates' successes will be notified to the centre at which they were examined.

## GRADE II.

The Examination in Grade II will include more advanced questions on the subjects of the Syllabus for Grade I, and, in addition, a knowledge will be required of:—

1. **CHARACTERISTICS OF THE VARIOUS SURFACES** employed in lithography—stone and metals. Chemical and physical principles on which lithography is based.

*Stone.*—Origin, mineral character and composition of the lithographic stone. Power planing, grinding, and polishing methods. Backing of thin stones.

*Aluminography.*—The various methods of preparing aluminium plates and transferring upon them.

*Zincography.*—Plain and coated zinc plates; methods of treatment; methods of transferring upon and printing from them.

Alterations and corrections; recipes and solutions employed.

2. **PAPERS.**—Hand and Machine made; tinted; enamels (single and duplex coated); plain and glazed cards, their nature, qualities and sizes. Paper creasing and its remedies.

3. **INKS.**—Source and nature (simple physical and chemical properties) of coloured pigments. Ink mediums and pomades. Varnishes, oils, gums: mixing of tints and body colours. Action of driers. Influence of temperature on inks and printing surfaces.

4. **MACHINES.**—Construction and management,—Hand presses, power-driven, top-lever, side-lever and Broadway lithographic

presses. Flat-bed lithographic machines, side-lever and spiral-spring pressure types, rotary lithographic machines, English and foreign types; the various special small size, quick running, one-man machines.

5. ROLLERS.—Breaking in of “nap” and making of “glazed” rollers for machines; re-packing and re-covering machine rollers.

6. TRANSFERRING.—Lithographic transfer papers, smooth and grained. Transfer inks and crayons. Transferring for commercial and colour work. Corrections. Patching-up and shining-up for colour work. Treatment of drawings upon grained stones. Etching and proving.

7. Method of preparing work on stone to be etched into high relief.

8. CHROMOLITHOGRAPHY.—Superimposing of colours—registration; prevention of setting-off. Transparencies or window glacier work.

9. SHADING MEDIA.—The various kinds of stippling film. Splash work; aerograph.

10. Metal-leaf work, and bronzing by machine power. Copyable dust headings and circular work.

11. Pantographs and their management.

12. Photolithography by the various transfer paper methods.

13. Transposition process from black to white, and reverse image methods from left to right.

The Examination in Grade II and the Final Examination will be held on Wednesday, May 1st, from 7 to 10 p.m. The fee for either Examination is *One Shilling and Sixpence*.

#### FINAL EXAMINATION.

*Candidates for the Final Examination must hold a Certificate in Grade II.*

The questions will not be limited to any particular syllabus, but will be based upon the groundwork of the syllabuses for the previous grades, with a wide range of the whole subject of Lithography and allied printed processes, and will include such subjects as the following:—

1. TESTING OF MATERIALS.—More advanced knowledge of the chemical and physical properties of pigments.

2. COLOUR.—The primary colours and their combinations; absorption of colour.

Colour harmony and contrast.

3. MISCELLANEOUS PROCESSES.—Transferring from intaglio, relief and flat surface printing media, such as copper and steel plate engravings, wood and metal blocks, collotype and similar printing surfaces.

Printing and simultaneous mounting of India paper proofs.

Lithographic printing on silk and other textile fabrics.

Advanced stone engraving work, and the engraving machine.

Graduated tint printing from machine and press.

Rotary and flatbed tinplate printing.

Decalcomanie transfer printing. Ceramic (pottery) lithography.

Spangle (tinsel), Flock and Snow-powder work.

Graining and embossing printed chromo-work from lithographic machine.

Varnishing and gelatining of colour work.

Three-colour lithography. Methods of colour printing analogous to lithography.

Direct photolithography on metal plates and stone.

Halftone and grained high-light lithographic process.

Copper plate printing. Etching, drypoint, aquatint and mezzotint engraving.

Photogravure and its combination with lithography.

Collotype and collotype in combination with lithography.

Irregular-grain photo-chromo-litho processes. Photo-stone process and other photo mechanical processes, as photochrome, etc.

5. MACHINES.—Types of the two and three-colour rotary litho-machines. Rotary three-cylinder rubber offset machines.

Recent lithographic inventions and innovations, automatic feeders, register finders.

6. ESTIMATING for lithographic work ; setting out transfers and necessary number to be transferred up ; quantity of paper ; amount of ink, &c.

7. PAPER.—Tests for the printing properties ; papers suitable for particular classes of work.

II. Full Technological Certificate.—For the Full Technological Certificate, the Candidate will be required to qualify as stated in Rules 29 and 30, but Certificates shewing that he has passed the Examinations of the Board of Education in Geometrical Drawing, as well as in Freehand or Model Drawing, will be accepted in lieu of one of the Science Certificates.

III. Works of Reference.—*Lithography*—"Grammar of Lithography," W. D. Richmond, c. 1894 (Menken, 5s.). "Colour and Colour Printing as applied to Lithography," W. D. Richmond, c. 1894 (Menken, 5s.). "Zincography," J. Bock, c. 1892 (Menken, 2s. 6d.). "Textbook of Metalography," C. Harrap (Raithby,

Lawrence & Co., 3s.). "Photo-lithography," G. Fritz, 1895 (Dawbarn & Ward, 5s.). "Collotype and Photo-lithography," J. Schnauss, 1894 (Iliffe & Son, 5s.). "Manufacture of Varnishes, Oil Crushing, Refining and Boiling," Livache and McIntosh, 1899 (Scott, Greenwood & Co., 12s. 6d.). "Treatise on Photogravure," H. Denison, c. 1894 (Iliffe & Son, 4s. 6d.).

*Colour*—"Science of Colour Mixing," D. Paterson, 1900 (Scott, Greenwood & Co., 7s. 6d.). "Colour: A Handbook of the Theory of Colour," G. H. Hurst, 1900 (Scott, Greenwood & Co., 7s. 6d.). "Dictionary of Chemicals and Raw Products used in the Manufacture of Colours, Varnishes, etc.," G. H. Hurst, 1901 (Scott, Greenwood & Co., 7s. 6d.). "Field's Chromatography." J. Scott Taylor, B.A. (Windsor & Newton).

*Paper*—"Practical Paper-making," G. Clapperton, 1894 (Marchant Singer & Co., 5s. 4d.).

## 51.—THE OCCURRENCE, RAISING, AND DRESSING OF ORES.

I. Syllabus.—The Examination will include questions founded such subjects as the following:—

### GRADE I.

1. Nature and classification of ore deposits, their distribution and importance, the changes that they undergo, and the irregularities and interruptions to which they are subject. Outcrops and surface indications of ore deposits.

2. Prospecting; boring by percussive and rotary methods.

3. Hand tools for breaking ground, hand and machine drilling, blasting, theory of explosives, shot-firing.

4. Driving levels and securing them by different forms of supports; driving through running ground, special methods of driving.

5. Sinking shafts and securing them by various methods; sinking in wet and running ground; special methods of sinking.

6. Working mineral deposits by stoping, caving, stowing and other methods; hydraulic mining.

7. Transport underground and on the surface: mechanical haulage; locomotive haulage; self-acting inclines, aerial ropeways, &c.

8. Hoisting in kibles, skips and cages; shaft equipment; head-gears and surface arrangements; winding engines and appliances.

9. Mine drainage by various methods, hoisting water, pumping and pitwork ; pumps of various types ; mine dams.

10. Principles of mine ventilation ; need for ventilation ; natural ventilation ; furnace ventilation, mechanical ventilation ; distribution, regulation and measurement of air currents.

11. Principles of dressing ; hydraulic, pneumatic, magnetic and other methods of dressing.

12. Sizing or screening ; fixed and moving screens.

13. Crushing machines working by impact, pressure and attrition.

14. Appliances for dressing in horizontal and vertical currents of water ; classifying ; jigging ; dressing on fixed, moving and shaking tables. Magnetic and other separators.

15. Application of dressing to special cases.

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#### FINAL EXAMINATION.

More advanced questions will be set in the above subjects, and candidates will be expected to show a greater knowledge of detail, also of dimensions, proportions and costs, together with an acquaintance with such subjects as statistics of mineral production and mine accidents, systems of employment and payment of men, principles of mine accounts, economic and commercial considerations, estimates and specifications of mining machinery, plant and mining operations, mineral rights, tenure of mineral property, mining legislation. Candidates will also be expected to have a fuller knowledge of the theory of the subject, including genesis of mineral deposits, theories of explosion and detonation, strength of materials used for supporting excavations, designing of air-compressing, hoisting, pumping, ventilating and dressing plant.

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The Examination in both Grades will be held on Wednesday, May 1st, from 7 to 10 p.m. The fee for the Examination in either Grade, is *One Shilling*.

II. Full Technological Certificate.—For the Full Technological Certificate, the Candidate will be required to qualify as stated in Rules 29 and 30.

III. Works of Reference.—“A Treatise on Ore Deposits,” J. A. Phillips and H. Louis (Macmillan & Co., Ltd.) ; “The Nature of Ore Deposits,” Dr. R. Beck, translated by W. H. Weed (“Engineering and Mining Journal”) ; “A Textbook of Mining Geology,” J. Park (Chas. Griffin & Co. Ltd.) ; “The Geology of Ore Deposits,” by Thomas and MacAlister (Edward Arnold) ; “Elements of Mining,” C. Le Neve Foster (Chas. Griffin & Co. Ltd.) ; “Ore and Stone Mining,” C. Le

Neve Foster (Chas. Griffin & Co. Ltd.); "Principles of Mining," by H. C. Hoover (Hill Publishing Co., Ltd.); "Lehrbuch der Bergbaukunde," G. Köhler (Wilhelm Engelmann); "Cours d'Exploitation des Mines," Haton de la Goupillière (Ch. Dunod); "Dredging for Gold in California" D'Arcy Weatherbe (Mining and Scientific Press); "The Witwatersrand Goldfields; Banket and Mining Practice," S. J. Truscott (Macmillan & Co., Ltd.); "Handbook of Gold-Milling," H. Louis (Macmillan & Co., Ltd.); "The Dressing of Minerals," by H. Louis (Edward Arnold); "Ore Dressing," R. H. Richards ("Engineering and Mining Journal"); "The Practice of Ore Dressing in Europe," W. H. Kunhardt (Chapman & Hall, Ltd.); "Lehrbruch der Aufbereitungskunde," P. v. Rittinger (Ernst & Korn); "Grundriss der Erzraufbereitung," Kirschner (Franz Deuticke); "Mine Accounts," J. G. Lawn (Chas. Griffin & Co., Ltd.); "The Organisation of Gold Mining Business," Nicol Brown (E. & F. N. Spon, Ltd.). The Transactions of the American Institute of Mining Engineers, of the Institution of Mining Engineers, of the Institution of Mining and Metallurgy. Mines and Quarries—General Reports and Statistics (H.M. Stationery Office).

## 52.—MINE SURVEYING.

The Examinations will be held in three grades, of which Grade I will be of an elementary character. Candidates for Grade II must in general have previously passed in Grade I, and Candidates for the Final Examination must have previously passed in Grade II.

No high standard of mathematical knowledge will be expected from Candidates for the Examination in Grade I; only as much geometry and mensuration as is needed for solving questions in surveying, together with elementary notions of trigonometry.

*The usual drawing instruments and simple scales (say 10, 20, 30, and 50 divisions to the inch) will be required. Candidates should also be provided with tables.*

No certificates will be awarded on the results of the Examination in Grade I, but the Candidates' successes will be notified to the centres where they were examined.

### I. Syllabus.—

#### GRADE I.

The Examination in Grade I will include questions on:—

1. British and metric measures of length and area.
2. Scales, their construction and use.
3. Contracted methods of the arithmetical operations required in surveying calculations.

4. Practical geometry of straight line, circle, angles, triangles, and simple plane figures. Areas of plane figures. Simpson's rule. Volumes of prisms, prismoids, and pyramids.

5. Trigonometrical relations between sides and angles of plane triangles. Co-ordinates.

6. Use of mathematical tables—chiefly logarithmic and traverse tables. Applications of geometry and trigonometry to the solutions of simple problems in mensuration and surveying.

7. Plotting traverses by protractors, chords, and rectangular co-ordinates.

8. Elementary properties of magnetic needle. Construction of simple telescopes. Elementary mathematical geography.

9. Ranging; simple surveying by the chain alone. The surveyor's chain, arrows, plumb-bob, ranging-rods, &c. The plain miner's dial and its use.

10. Methods of determining density of solids. Approximate densities of more common minerals. Calculations of quantities of mineral.

The Examination in Grade I will be held on **Monday, April 29th**, from 7 to 10. The fee for the Examination is *One Shilling*.

#### ORDINARY GRADE.

*Candidates for Grade II will in general be required to have passed the Examination in Grade I in a previous year. Those Candidates, however, may be exempted from taking the examination in Grade I who can produce a certificate from the Professor of a University that they have acquired an adequate knowledge of the subjects included in the syllabus for that grade.*

Each Candidate will be required to provide himself with the following instruments, &c.:—Circular protractor, rolling parallel ruler, plotting and off-set scales, box of mathematical instruments, drawing-board and pins, india-rubber, brushes and pencils, Indian-ink and a few simple colours, palette or nest of saucers, mathematical tables, including logarithms of numbers, natural and logarithmic functions of angles, &c.; traverse tables may also be used.

The Examination will include questions on the subjects of Grade I, together with the following:—

Measurement of distances; measurement on slopes; clinometer; plotting surveys; calculating areas; taking out quantities; application of trigonometry to surveying problems; the plane table; the rapid traverser; dialling; racking or fast-needle dialling; various forms of theodolites and their use; triangulation and traversing with the theodolite; laying out surface and underground workings; levelling by various methods; measuring the depths of shafts; making sections; setting out railways;

connecting surface and underground surveys; valuation of minerals; miscellaneous problems.

The Examination in Grade II and the Final Written Examination will be held on Tuesday, April 30th, from 7 to 10 p.m. The fee for the Examination in Grade II is *One Shilling and Sixpence*. The fee for the entire Final Examination (Written and Practical) is *Ten Shillings*.

### FINAL EXAMINATION.

*Candidates for the Final Examination must hold a Certificate in Grade II.*

The Final Examination will occupy at least *two days*, and will be in part Practical.

(1.) **Written and Practical Examination.**—The Examination will include more difficult questions on the subjects of Examination in Grade II, together with special methods of surveying as practised in this and other countries; observations on movements of the surface and ascertaining the probable origin of the movements, whether by mining or otherwise; laying out safety-pillars; tachemetry; photographic surveying; surveying for deposits of, or containing, magnetic minerals by magnetometric observations; surveying bore holes; determining local time, geographical position and direction by solar and stellar observations; investigating the degrees of accuracy attained in the various elements of ordinary mine-surveying operations; use of the method of least squares; the means to be used to attain the required degree of accuracy in precise surveying and setting-out; generally speaking any problems that may arise in miscellaneous surveying practice.

Students will be required to provide themselves with the same appliances as for Grade II; they may also be called upon to provide themselves with any surveying instruments for the Practical Examination, due notice of which will be given.

(2.) **Specimen Work.**—Candidates will also be required to submit drawings of one piece of survey work and one piece of levelling, carried out during the twelve months preceding the examination. The survey may have been carried out either above or below ground, but the work chosen should be such as will show the Candidate's skill and accuracy. The field-book, notes, and all calculations must be forwarded with the drawing. The work must be forwarded so as to reach the Offices of the Department not later than April 29th.

Such work should, if possible, be executed under the supervision of the class teacher, but without his help. In such cases, a certificate signed by the Class Teacher and a Member of the School Committee, stating that the work has been executed by the



Candidate himself, without other assistance than that of an ordinary staff bearer, chainman or chainmen, &c., none of whom shall be surveyors, must be forwarded with the drawing. In cases where the work has been executed by the Candidate without supervision, a Statutory Declaration will be required. Forms for either the Certificate or the Declaration may be obtained on application.

The Final Written Examination will be held on Tuesday, April 30th, from 7 to 10 p.m., and the Practical Examination at Cardiff and at a centre in the North of England, of which notice will be given, on dates to be subsequently fixed.

The fee for the Final Examination is *Ten Shillings*.

**II. Full Technological Certificate.**—For the Full Technological Certificate the candidate will be required to qualify as stated in Rules 29 and 30.

**III. Works of Reference.**—"A Treatise on Mine Surveying" Bennett H. Brough (Charles Griffin & Co., Ltd.); "A Practical Treatise on Mine Surveying," Arnold Lupton (Longmans & Co.); "Colliery Surveying," T. A. O'Donahue (Macmillan & Co., Ltd.); "Subterraneous Surveying," T. Fenwick and T. Baker (Crosby Lockwood & Son); "Mineral Surveyors' and Valuers' Complete Guide," W. Lintern (Crosby Lockwood & Son); "Practical Surveying," G. W. Usill (Crosby Lockwood & Son); "Surveying," by John Whitelaw, Jun. (Crosby Lockwood & Son); "Principles and Practice of Levelling," by F. W. Simms (Crosby Lockwood & Son); "Surveying and Levelling Instruments," by W. F. Stanley (E. & F. N. Spon); "Mathematical Tables," J. Pryde (W. & R. Chambers, Ltd.); "Traverse Tables," with an introductory chapter on Co-ordinate Surveying," Henry Louis and G. W. Caunt (Arnold, 1901); "Traverse Tables," J. T. Boileau (W. H. Allen & Co., Ltd.); "Traverse Tables," R. L. Gurden (Charles Griffin & Co., Ltd.); "Practical Navigation," J. W. Norie (Norie & Wilson); "The Colliery Manager's Handbook," C. Pameley (Crosby Lockwood & Son).

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### 53.—SLATE QUARRYING.

**I. Syllabus.**—The Examination will include questions founded on the following subjects:—

#### GRADE I.

1. *Mode of Occurrence of Slate.*—Stratification.—Nature and composition of slate. Slaty cleavage. Properties of good roofing slate. Faults and other interruptions. Various kinds of faults. Measurement of their throw. Rules for searching for a bed beyond a fault or dislocation. Dip and strike. Geological age of slate deposits. Igneous masses and dykes: their effect on slaty formations. Surface indications. Boring in search of slate.

2. *Excavations.*—Hand tools, drills, jumpers, scrapers, stemmers, crowbars, wedges. Boring machines worked by steam, compressed air, and electricity. Mechanical methods of cutting slate rock *in situ*.

3. *Explosives and Blasting.*—Kinds of explosives used. Their composition. Noxious products of explosion. Fuses, detonators, charging, stemming, methods of firing, safety fuse, electric fuse. Miss-fires.

4. *Supports.* — Artificial supports for certain excavations. Materials used, and how employed.

5. *Modes of Working.*—(1) Openworks (*a*) In steps or galleries, (*b*) In pits. (2) Underground slate quarries (*a*) Chambers and permanent pillars, (*b*) Filling-up method.

6. *Haulage.*—Waggons and sleds: construction and dimensions. Rails, sleepers, turntables, cranes; haulage by men, horses and machinery.

7. *Winding.*—Shafts. Inclined planes: self-acting, water-balance, aerial inclines. Winding engines, drums, ropes of various kinds. Laying out of roads and inclined planes.

8. *Drainage.*—Adit levels. Pumps of various descriptions employed above and below ground.

9. *Ventilation.*—Composition of air. Injurious gases met with in slate mines: how produced; their composition. Tests. Natural and artificial ventilation.

10. *Lighting.*—Candles. Lamps of various descriptions. Wells' light. Magnesium lamp. Acetylene light. Electric light.

11. *Descent and Ascent.*—Construction and arrangement of ladders. Paths, steps, cages.

12. *Preparation for Market.*—Hand tools and machinery employed. Sub-division of blocks, splitting, dressing. Sizes and qualities of slates.

The Examination in both Grades will be held on Tuesday, April 30th, from 7 to 10 p.m. The fee for the Examination in either Grade is *One Shilling*.

#### FINAL EXAMINATION.

In the Final Examination more difficult questions will be set in the above subjects, and in addition a knowledge will be required of—

1. *Plans and Sections.*

2. *Payment of work done.*

(*a.*) By time.

(*b.*) By measure.

(*c.*) By contract.

3. *Legislation.*—Laws relating to the working of slate mines and slate quarries.

4. *Accidents.*—Nature of accidents. Means of preventing them.

II. *Full Technological Certificate.*—For the Full Technological Certificate the Candidate will be required to qualify as stated in Rules 29 and 30.

III. *Works of Reference.*—"The Elements of Mining and Quarrying," by Sir C. Le Neve Foster (Charles Griffin and Co., 1904); "Ore and Stone Mining," by Sir C. Le Neve Foster (Charles Griffin and Co.); "Slate Quarrying," by D. C. Davies (Crosby Lockwood).

## 54.—CARPENTRY AND JOINERY.

With the view of encouraging Apprentices to take a continuous course of instruction in this subject, the first Examination, Grade I, will be of an elementary character. No Certificates will be given to Candidates on the results of the Examination in Grade I, but their successes will be notified to the centre at which they were examined. It may be necessary that some Apprentices should attend a two years' course of instruction before presenting themselves for Grade I. This will depend upon their state of preparation on leaving school.

In order to encourage excellence of craftsmanship in this subject, the Institute of Builders offers a First Prize of 30s. and a Silver Medal, and a Second Prize of 20s. and a Bronze Medal, to those candidates who obtain the highest number of marks for Practical Work in the Final Examination and who also qualify for a First Class Certificate in the Final Written Examination.

A First Class Certificate awarded on the results of the Final Examination in Carpentry and Joinery is a qualification for membership of the Incorporated British Institute of Certified Carpenters.

*Candidates for either Grade I, Grade II, or the Final Examination should be provided with Drawing Instruments. Drawing paper is supplied by the Institute.*

### I. Syllabus.—

#### GRADE I.

The Examination in Grade I will include questions founded on the following subjects, divided into three sections, and Candidates will be required to show some knowledge of the subjects under

each Section ; the subjects of sections I and II should be taught, as far as possible, in connection with the subjects of Section III. :—

### *Section I.*

1. Comparisons between the British and Metric systems of units, of length, area and volume.
2. Calculations of areas of plane surfaces, floors, walls, roofs, &c.
3. Measurement of relation of circumference of circle to diameter, arcs, chords, &c.
4. Measurement of the cubic contents of simple solids, as cube, prism, pyramid, cone and sphere.
5. Division of straight line into parts and elementary problems in practical plane geometry. Construction and use of scales.
6. Construction of square equal to area of any irregular figure bounded by straight lines.
7. Properties of circles as applied to simple mouldings and the setting out of circular arches.

### *Section II.*

1. Principle of parallelogram and triangle of forces, and simple problems thereon.
2. Simple mechanical contrivances, such as lever, pulley, screw. Problems illustrating their uses.
3. Practical determination of the specific gravity of different woods.
4. Principle of moments applied to parallel forces, as in beams under concentrated loads.

### *Section III.*

1. The principal hand-tools used in Carpentry and Joinery, their names, shapes, uses, &c.
2. The names and brief descriptions of the more common woods generally used in Carpentry and Joinery.
3. The names and shapes of the commoner forms of mouldings.
4. Construction of plan, elevation and section of simple solids.
5. The practical setting out of simple pieces of Carpentry and Joinery, such as door-frames, king post roof trusses, simple plane figures, including circular and elliptic curves.
6. Representation in oblique and isometrical projection of solid figures, and also of the chief simple joints used in Carpentry and Joinery.

The Examination in Grade I will be held on Monday, April 29th, from 7 to 10 p.m. The fee for the Examination is *One Shilling*.

## GRADE II.

*Candidates for Grade II will be required to have passed in Grade I, unless over 21 years of age or certified by their teachers to possess an adequate knowledge of the subjects included in the Syllabus for Grade I.*

In addition to practical applications of the foregoing, Candidates will be expected to possess a knowledge of the following subjects in each section :—

*Section I.*

1. The complete geometrical drawings required for arches such as elliptical, four-centred, pointed, &c.; obtaining their normals and tangents.
2. Inclination of lines and planes and ways of obtaining dihedral angles as applied in setting out the bevels in roof-work.
3. Development and measurement of surfaces of simple solids.
4. Intersection of mouldings at different angles, also of straight and circular mouldings lying in one plane, enlarging and diminishing mouldings and stair brackets, determining the true section of vertical angle-bars and raking mouldings over square plans.

*Section II.*

1. The mechanical principles required in framing simple roof trusses, timber partitions, trussed girders, &c.; determining the stresses in the various members by graphic statics.
2. The mechanical principles and practical methods of strengthening beams and girders by flitching, trussings, &c.

*Section III.*

1. The proportion of the various parts of Carpenters' and Joiners' work, such as doors, windows, roofs, floors, &c.
2. The proportion tenons and dovetails should bear to the thickness and width of material, with due regard to strength, the correct design of joints to resist strain in roof trusses, scarfing, bolts, straps, keys, &c., used to secure joints.
3. Hand tools : their names, shapes and uses.
4. Setting out rods, and material showing shoulder lines, &c., of panelled and framed and braced doors, door frames, jamb linings, French casements, boxing and hanging shutters, double-hung sashes and cased frames, &c.
5. The use of the steel square in practical roof work.
6. Doglegged and open newelled stairs : proportion of tread and riser, details of constructions and methods of support.
7. Hinges and the modes of applying them, centre pins, back flap, butts, butterfly and various kinds of spring hinges. Centres

as applied to pivot hung sashes, the sizes and position of pulleys in double hung sash frames, with all provision for joints and finishing work.

8. The preparation and fixing of weather boarding and weather boards, the position and proportion for throatings, condensation grooves, &c., in skylights, sills and all woodwork exposed to the weather.

9. Preparation and fixing woodwork, such as grounds, linings, architraves, bracketings, beads, &c., with necessary grooves and bevels for plasterer; gutters, cesspools, rolls, drips, mouldings, finials, &c., for plumbers; boarding, battens, tilting fillets, &c., for slaters and tilers.

10. The design and construction of centres for segmental and circular brick arches up to 15 ft. span, with the methods of easing and striking them.

The timbering in trenches to receive drains, &c., for various soils of depths to 14 feet.

Fixing shuttering for walls and floors in reinforced concrete.

11. Nature and properties of the various kinds of wood used in Carpentry and Joinery, their defects and the parts or places from which they are obtained. Methods of seasoning and preservation of timber, mode of converting timber for general builders stock.

The Examination in Grade II will be held on **Saturday, April 27th**, from 2.30 to 6.30.

The fee for the Examination is *One Shilling and Sixpence*.

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### FINAL EXAMINATION.

*Candidates for the Final Examination must hold a Certificate in Grade II.*

The Examination will be divided into two parts (1) Written (including drawing), and (2) Practical.

(1.) **Written Examination.**—Advanced questions in any of the preceding subjects may be set and in addition, a knowledge of the following subjects in each section will be required :—

#### *Section I.*

1. Setting out geometrical curves, such as parabola and hyperbola, and the best practical way of obtaining their parallels, normals and tangents.

2. Moulds, bevels and developments required for soffits in straight and circular walls, also for ribs in groins, domes, niches, pendentives and work of double curvature.

3. Handrailing, the theory and use of tangent planes and falling lines, preparing face moulds and bevels and the method of applying

them, method of setting out handrail scrolls, &c., the development of strings for geometrical stairs.

4. The intersection of raking mouldings over oblique and curved plans, and the methods of determining varying sections.

### *Section II.*

1. Calculations of stress in timber beams and cantilevers under various loads, effective designing of joints in beams, joists and constructional carpentry.

2. The various methods of testing the value of certain woods for constructional purposes or temporary work where strength is required.

3. The cause of figure in wood and how it can be detected in the log before converting.

4. Conversion of timber to obtain the maximum strength and stiffness or display the various types of figure for which certain woods are noted.

5. Planning stairs, taking dimensions from buildings and measurements for work. Working from scale drawings and preparing details suggesting how various parts may be fitted together.

6. Preparing and using glue and other adhesives. Knowledge of their properties and practical testing of same.

### *Section III.*

1. The various methods of constructing large centres for circular, segmental, elliptical and other arches and the methods employed to fix and ease them.

2. Different forms of timbering for foundations and reinforced concrete work, scaffolding, staging and gantries, shoring, derrick, towers, &c., with a clear knowledge of their requirements to ensure safety. Temporary buildings and half timber work.

3. Circular work. Method of constructing strings for geometrical stairs, ribs and mouldings in circular work by bending, building up, laminating, grooving, &c.

4. Construction of fittings for churches, museums, public-buildings, shops and domestic work, such as pews, stalls, show cases, shop fronts, fitments for butler's pantry, housekeeper's room, &c.

5. Labour-saving machinery, circular, frame and band saws. Planing, morticing, tenoning and moulding machines, &c. Knowledge of their management and control and the systematic handling of work.

The Candidate will be required to execute drawings to scale from data furnished by the Examiner.

(2.) **Practical Examination.**—The Practical Examination will include :—(a) Practical Exercises to be worked from a rod or drawing within a prescribed time ; (b) Specimen Work designed and executed by the Candidate.

(a) The Practical Exercises must be worked in a Carpenter's Shop, and will be of such a character as to test the Candidate's ability as a craftsman. The exercises may include any important piece of Carpentry such as the following, but care will be taken that no more than four hours' work will be required in any exercise set. If a large piece of work is chosen, only a portion will be required to be executed :—

1. A moulded rib.
2. Details of sashes, and frames, and casements.
3. Portion of a dado fitting.
4. Portion of the end of a church pew.
5. Portion of the soffit of a boxing shutter.
6. Hinging of any joiners' work.
7. Detail of a floor.
8. Detail of a roof.
9. A small centre.

**NOTE.**—No work will be allowed to be glued up, nor is any glass-paper to be used.

The material for the Practical Test will be supplied by the Institute.

The Examiners in determining the results of the practical test will take into consideration the accuracy and finish of the work.

The Final Written Examination will be held on Saturday, April 27th, and the Practical Test on Saturday, May 18th, from 2.30 to 6.30. The fee for the entire Examination is *Three Shillings and Sixpence*.

(b) **Specimen Work.**—Each Candidate will be required, during the year preceding the Examination, to design and execute in suitable material an original piece of work, and to forward the same to London (carriage paid) on or before May 13th. The specimen of work must be accompanied by a working drawing, with particulars of quantity and nature of materials used, and must be of such dimensions that it will fit into a box not larger than two cubic feet.

A Certificate signed by the Candidate's employer or by the Class Teacher and a member of the School Committee, stating that the work has been executed by the Candidate himself, without assistance, *must be forwarded with the specimen*. In cases where the work has been executed at the Candidate's own residence, a Statutory Declaration will be required. Forms for either the Certificate or the Declaration may be obtained on application.

**NOTE.**—Specimens are preferred which are sufficiently large to show the practical work and are loosely "wedged up" so that they



can be taken to pieces for examination. They should not be polished nor varnished. If the specimen is made to a small scale, Candidates should make in addition portions to an enlarged scale, showing the construction.

**II. Full Technological Certificate.**—For the Full Technological Certificate, the Candidate will be required to qualify as stated in Rules 29 and 30, but Certificates showing that he has passed the Examinations of the Board of Education in Geometrical Drawing, as well as in Freehand or Model Drawing, will be accepted in lieu of one of the Science Certificates.

**III. Works of Reference.**—"Rivington's Notes on Building Construction" (Longmans); "Drawing for Carpenters and Joiners" (Cassell); "Handrailing and Staircasing" (Cassell); "The Carpenters and Joiners' Assistant," by J. Newlands; "The Principles of Carpentry," by Tredgold (revised by Hurst); "Strength of Timber, &c.," by P. Barlow; "The Strength of Materials," by Sir John Anderson; "Handy Book on Strains," by W. Humber; "A Treatise on the Construction of Staircase and Handrails," by P. Nicholson; "A Treatise on Shoring and Underpinning," by C. H. Stock; "Timber and some of its Diseases," by H. Marshall Ward; "Building Construction," by C. F. Mitchell (Batsford); "Carpentry and Joinery," by F. C. Webb (Methuen). "Modern Practical Joinery," by G. Ellis (Batsford, 1908); "Modern Practical Carpentry," by G. Ellis (Batsford, 1906).

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## 55.—SHIP BUILDERS' WORK.

Separate examinations will be held in A.—Ship Carpentry; B.—Ship Joinery; C.—Iron and Steel Shipbuilders' Work.

### A.—SHIP CARPENTRY.

**I. Syllabus.**—The course of instruction is intended to cover at least two years. The Examination will include questions founded on, and having special reference to, such subjects as the following :—

#### GRADE I.

1. The various kinds of wood used in shipbuilding, their nature, properties and defects, and the countries from whence chiefly obtained. The purposes for which they are best adapted.

Different methods of seasoning and preserving timber.

2. Tools—their names, proper handling, principles of construction, methods of hardening, sharpening, and using them.

Wood-working machines—their general principles of construction.

A general knowledge of the wood-work fitted by ship carpenters which enters into the construction of modern ships. The manner of siding and moulding timber. How to best dispose of timber for economy, appearance, strength and stiffness. Waste on converting timber.

Weights of the more important materials used in Ship Carpentry. Simple calculations of weight, measurement of quantities and estimates of cost.

3. The varieties and uses of the accessories required in construction, such as pitch, marine composition, oakum, felting, &c.

4. How to arrange shift of butts in skin planking in sheathed and composite vessels, and fit the planking. How to work deck planking and waterways, including shift of butts and bolting. Bevel scale. Finish of the ends of erection decks. Armour backing.

Construction of stem, stern post, keel, bilge keels, deadwood, and skin planking in composite and sheathed vessels, with arrangement of fastenings and the necessary precautions to secure watertightness.

5. Wood masts, spars, and detail work generally in connection with a ship's rigging and outfit. Lightning conductors.

Construction of wood bulkheads, permanent and portable. Fitting of ceiling and sparring. Tunnel cleating. Shifting boards.

Various methods of scarfing timber.

Dowelling, tonguing and dovetailing wood joints.

Grounding and lining of ship's sides and iron bulkheads when either fixed or portable.

Cargo hatches, covers, mountings, and fore and afters.

Deck houses and companions. Mast step and wedging. Fife rail around masts. Belaying pins and cleats. Pin rack along sides of ship. Bulwark rail fastenings and butt arrangement. Harness casks, water casks, &c.

Fitting bollards, rail stanchions, windlass bed, samson-posts, knight heads, rail and name boards, figure head, stern carving, roller fenders, rudder-head stuffing box, &c.

Boat davits, skids, and chocks. Anchor arrangements, stowage, slip, chocks, &c. Cathead and anchor cranes. Fore and aft gangways. Breakwater forward. Fitting waist anchors. Flush deck lights.

6. Principles of docking and undocking of vessels, and a general elementary knowledge of dock and slip work.

7. Making of freehand sketches. Explanatory working drawings to scale.

Grade I is *One Shilling and Sixpence*, and for the Final Examination *Two Shillings and Sixpence*.

Candidates for either Grade should be provided with Drawing instruments. Drawing paper is supplied, if necessary, by the Institute.

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#### FINAL EXAMINATION.

*Candidates for the Final Examination must hold a Certificate in Grade I.*

The Examination will be written and practical.

(1.) **Written Examination.**—

More difficult questions will be set in the subjects of the syllabus for Grade I, and in addition a knowledge will be required of:—

1. The nature of the effect of timber on iron or steel in contact, also its effect upon the fastenings.

Comparative strengths of different kinds of timber used in ship-building and of iron and metal bolts. Meaning of terms "limits of elasticity" "working strength," "working load," "stress," "strain," and other like terms.

Fitting of copper and other sheathing in composite and sheathed ships, and the precautions adopted to prevent injury from galvanic action. Setting off on the ship the line of copper.

In war vessels, the armour plating, backing, magazines, shell rooms, light boxes, &c.

Paddle wheel box, construction and fittings.

2. Different means adopted for lifting heavy weights, such as the lower masts, into position by the derrick arrangement.

Detail arrangement of a portable gangway from a quay to a ship afloat.

3. Estimate of the weight and the cost of laying and completing a wood deck, also sparring and ceiling, and skin planking.

4. The laying-off of iron or steel ships, mercantile and war, on the loft floor. Construction of permanent scribe board. Preparing scribe board, lifting bevels, stern cants. The order of making the necessary moulds. Expansions for longitudinal girders, tank sides, stern plating, deck stringers and plating, &c. Armour plating moulds for manufacturer. The method of determining and fairing up the bossing in way of the shafting of a twin-screw ship. Determination of hawser holes, and other like problems.

Taking off the planking on the loft floor in sheathed and composite ships, and other points of laying-off connected with the sheathing.

5. Piling, uprights, scaffolding, staging, gangways, &c., in connection with yard berths.

6. Laying and bevelling of keel blocks; height of foremost block. Bilge blocks. Laying and marking off the keel. Skid blocks. Erecting frames; explanation of plumbing and horning, ribbanding and shoring frames. Erection of stem and stern posts into their positions and shoring same. Lifting from scribe board and laying-off on the loft floor the points for the ribbands. Trimming and fixing ribbands and harpins. Fixing and fairing beams in position. Fairing up shell plating edges on ship. Fairing up and ribbanding decks. Ribbanding and shoring into correct position a cellular bottom.

7. Arrangement of the launching ways in an ordinary merchant vessel, including declivity, camber, weight, composition of lubricant, &c. Bow platform.

Launching diagram. Launching a vessel.

Arrangement of the launching ways in a battle ship, and the precautions taken.

8. Docking and undocking. Dock and slipwork in general. Elementary theory of the strains upon shores and blocks. Ties and struts. Strength of girders supported and loaded in various ways. Graphic explanation of loads, shearing stresses and bending moments.

9. Repairing work. Leak stoppers and temporary repairs.

10. Refrigerating chambers, insulation of holds, &c., and cattle-boat fittings.

11. Inclining a vessel in the water to ascertain the position of her centre of gravity; necessary preparations.

12. Making descriptive plans to scale, also freehand sketches from actual work.

(2.) Specimen Work.—Each candidate will be required, during the twelve months preceding the Examination, to design and execute in suitable material an original piece of work, and to forward the same to London (carriage paid) on or before April 29th. The specimen of work must be accompanied by a working drawing with particulars of quantity and nature of materials used, and should consist of a model of some piece of work such as:—

1. Part of launching ways and building blocks.

2. Stem or stern post of a composite vessel, showing deadwood and keel connections and fastenings.

3. Boat chocks, davits, &c.

4. Timber heads and fastenings.

5. Different methods of scarfing.

The model should be of such dimensions that it will fit in a box not larger than *two* cubic feet.

A Certificate signed by the Candidate's employer or by the Class Teacher and a member of the School Committee, stating that the work has been executed by the Candidate himself, without assistance, *must be forwarded with the specimen*. In cases where the work has been executed at the Candidate's own residence, a Statutory Declaration will be required. Forms for either the Certificate or the Declaration may be obtained on application.

**II. Full Technological Certificate.**—For the Full Technological Certificate, the Candidate will be required to qualify as stated in Rules 29 and 30, but Certificates showing that he has passed the Examinations of the Board of Education in Geometrical Drawing, as well as in Freehand or Model Drawing, will be accepted in lieu of *one* of the Science Certificates.

**III. Works of Reference.**—For principles of work and properties and treatment of timber, see List of Works of Reference under Carpentry and Joinery, Subject 54. "Practical Shipbuilding," by Holmes, and "Laying-off, Iron, Steel, and Composite Vessels," by T. H. Watson, will be found useful on laying-off and general shipbuilding.

## B.—SHIP JOINERY.

**I. Syllabus.**—The course of instruction is intended to cover at least two years. The Examination will include questions founded on, and having special reference to, such subjects as the following:—

### GRADE I.

1. The various kinds of wood used in shipbuilding, their nature, properties and defects; and from what parts of the world chiefly obtained.

Methods of seasoning and preserving timber. Waste in cutting up.

Tools used in ship joinery—their names and uses—their handling, methods of hardening, sharpening, and using them—the principles of their construction.

Wood-working machines. Explanation of parts, and how and for what purpose used.

The uses of the various accessories required in construction, such as nails, screws, sand-paper, glue, &c.

2. A general knowledge of the joinery woodwork which enters into the construction of modern ships.

The practical setting out of simple pieces of joinery, such as door frames, deck and accommodation ladders, &c. Simple plane figures, including circular and elliptic curves.

The names and shapes of the commoner forms of mouldings; intersection of mouldings at different angles, also of straight and circular mouldings; enlarging and diminishing mouldings.

The best mode of planning and conversion of timber to avoid waste and shrinkage, and to obtain the maximum strength and stiffness.

Various simple joints and methods of scarfing timber.

Weights of the more important materials used in ship joinery. Simple calculations relating to weight and cost and measurement of quantities.

3. Construction of wood bulkheads, fixed and portable, and the fitting of ceiling and sparring. Dowelling, tonguing and dovetailing wood joints. Mortice and tenon—relation of width and thickness of material to size of same. Grounding and lining of ship's sides and iron bulkheads when either fixed or portable. Preparation and fixing of cants, toprunners and standards. Grounding and panelling of ceilings and casing of beams in cabins, saloons, &c. Veneering.

Methods of setting out the work and framing of passages, saloons, &c., from templates or levels taken at the ship, or from the mould loft floor. Making of moulds in the mould loft.

4. Fittings of state rooms and officers' cabins—beds, sofas, washstands, bookcases, wardrobes, writing desks, water bottle and glass rack, lavatories, lockers, &c.; how secured to the deck and bulkheads. Fittings of pantries—shelves, plate racks, cup hooks, dresser, bins, &c. Fiddle racks. Chart table and drawers.

5. Deck houses—their construction when wholly of wood or in combination with iron. Windows in deck houses with hung or sliding sashes.

Finish of erection deck ends.

Construction of doors to saloons, to deck houses, &c., and framing thereto. Sliding and hinged doors; how made watertight in exposed positions.

Hinges—various kinds and modes of applying them.

6. Storm shutters—how constructed for watertightness.

7. Construction of bucket racks, despatch box, coal box, medicine chest, hen coop, pig sty, &c.

8. Descriptive and explanatory working drawings to scale.

The Examination in both Grades will be held on Wednesday, May 1st, from 7 to 10 p.m. The fee for the Examination in Grade I is *One Shilling and Sixpence*, and for the Final Examination Grade *Two Shillings and Sixpence*.

Candidates for either Grade should be provided with Drawing Instruments. Drawing paper is supplied, if necessary, by the Institute.

## FINAL EXAMINATION.

*Candidates for the Final Examination must hold a Certificate in Grade I.*

The Examination will be written and practical.

(1.) Written Examination.—

More difficult questions will be set in the subjects of the syllabus for Grade I, and in addition a knowledge will be required of :—

1. The effect, injurious or otherwise, of timber on iron or steel when fastened thereto, and also its effect upon the fastenings. How to make wood incombustible.

2. Refrigerating chambers and insulation.

Skylights—how constructed and secured in position ; ordinary pitched, flat or circular tops. Hipped engine-room and skid skylights. Arrangement of gutters and joints to ensure watertightness.

Different kinds of companions—construction of slides, tops, doors, &c. Booby hatches and hatch coamings.

3. Accommodation ladders, adjustable and otherwise, with their platforms.

Deck and companion ladders and platforms with their fittings ; moulds for rails. Ladders to crew spaces, &c.

Steering wheels and covers for steering gear. Gratings and deck seats.

4. The best class of joiner work, such as side-boards, chairs, tables, drawers, bookcases and washstands. Decoration of pillars in saloons and cabins of first-class passenger vessels, circular dome, and a more advanced knowledge of ship joinery.

5. Curvilinear work, as *e.g.* deck houses, &c., with circular or elliptic ends. The curves, bevels, and joints of coamings to same—how obtained. Disposition and construction of stairs, with relation to economy of space, easy ascent, &c., straight or circular, with open or closed strings, how supported, height of handrail, framing, &c. How best to dispose of material for economy in cutting solid strings in carved or circular stairs.

6. Locks and other fittings, their construction and advantages. Design of ship's saloon panels.

7. Measurement of quantities and an approximate estimate of the cost of woodwork.

8. Comparative strength of different kinds of timber and of iron and metal bolts. Elasticity and resistance to elongation, compression and bending of different kinds of wood. Treatment and preservation of different kinds of wood. Strength of girders differently supported and loaded. Stress and strain. Graphic explanation of loads, shearing stresses, and bending moments.

Some explanation of the purposes of tie-rods and struts.

9. Freehand sketching from actual fittings and constructive drawings to scale.

(2.) Specimen Work.—Each candidate will be required during the twelve months preceding the examination, to design and execute in suitable material an original piece of work, and to forward the same to London (carriage paid) on or before April 29th. The specimen of work must be accompanied by a working drawing with particulars of quantity and nature of materials used, and should consist of a model of some piece of work such as:—

1. Framing of a deck house.
2. Framing of a stairway, with stairs.
3. Design of saloon panelling.
4. Framing of a saloon entrance, showing, *e.g.*, a door and windows.

The model should be of such dimensions that it will fit into a box not larger than two cubic feet.

A Certificate must accompany the work, as stated in the preceding Syllabus, p. 238.

II. Full Technological Certificate.—See the regulations for Section A, Ship Carpentry, p. 238.

III. Works of Reference.—See list of Works under Carpentry and Joinery, Subject 54. W. & A. Mowat's "Treatise on Stairbuilding and Handrailing," may be added, as containing chapters dealing specially with shipwork.

#### C.—IRON AND STEEL SHIPBUILDERS' WORK.

I. Syllabus.—The course of instruction is intended to cover at least two years. The Examination will include questions founded on such subjects as the following:—

##### GRADE I.

1. The construction of the component parts of iron and steel vessels, namely:—Keels, keelsons, hold stringers, deck stringers, deck ties, decks, shell, tank top and sides, centre longitudinal bulkheads, frames, web frames, floors, beams, W.T. and non-W.T. bulkheads, pillars, double bottoms, W.T. shoes, hatch coamings, ventilator coamings, deck houses, rudder trunks, stern posts, rudders, stems, struts, stern tubes, engine and boiler seating, shaft seating, shaft tunnel, masts, derrick posts, wash ports, cargo ports, scuppers, winch beds, waterways, bulwarks, deep water ballast tanks, mast steps, engine room skylights, &c.

2. Tools used by platers, drillers, caulkers, riveters, and hand machine tools.

3. Methods of making watertight work, and testing same.

4. Templates for the keel, keelson, tank side, shell, &c.



5. Details of riveting, and rivets required in the edges and butts of plates and bars.

6. Special reference to the construction of petroleum-carrying vessels.

7. A brief description of several of the working plans used in shipbuilding.

8. Methods of estimating the weight of iron or steel plates, pillars, sectional iron, &c.

9. Making of descriptive and explanatory small sketches. Use of scales.

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The Examination in both Grades will be held on Tuesday, April 30th, from 7 to 10 p.m. The fee for the Examination in Grade I is *One Shilling and Sixpence*, and for the Final Examination *Two Shillings and Sixpence*.

Candidates for either Grade should be provided with Drawing Instruments. Drawing paper is supplied, if necessary, by the Institute.

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#### FINAL EXAMINATION.

*Candidates for the Final Examination must hold a Certificate in Grade I.*

The Examination will be written and practical.

(1.) **Written Examination.**—1. A brief explanation of displacement and the application of Simpson's and other calculating rules for determining curvilinear areas.

2. Scribe board and platform work. Bending, bevelling, and punching frames and beams. Turning and punching floors. Trial test of the correctness of framing before erecting. Tools used on the boards.

3. General construction of cruisers and battleships.

4. An extended explanation of working plans.

5. The laying off and making of the necessary moulds, &c., for masts, longitudinals, rudder trunk, hatches, stern plating, turtle back, tank side, tank top, shaft tunnel, &c. Templating and preparing shell plates. Templating and preparing stringer and deck plating.

6. General description of yard machines, rolling, flanging, joggling, bevelling, multiple punch, drilling, punching, shearing, &c.

7. Meaning of the terms "limits of elasticity," "working strength," "working load," "factor of safety," "strain," "stress," "ultimate breaking strength," &c.

Elementary theory of stresses on ships afloat in still water and among waves, and the necessary strength fitted to meet these stresses. Calculation of the strength of structural parts and of riveted joints.

8. An explanation of different types of ships and their characteristics.

9. Calculation of the weight of material in structural parts, as bulkheads, decks, tank top, &c.

10. Methods of galvanising iron and steel plates. Treatment of mild steel used in shipbuilding. Preservation of material while building or on service.

11. Nature and properties of iron and steel plates, bars and rivets, as used in shipbuilding. Tests to which material is subject before considered fit for use.

12. Making of freehand and explanatory sketches of different of the work, as well as scaled drawings.

(2.) Specimen Work.—Each Candidate will be required during the twelve months preceding the Examination, to design and execute in iron and steel an original piece of work, and to forward the same to London (carriage paid), on or before April 29th. The specimen of work must be accompanied by a working drawing with particulars of quantity, and nature of materials used, and should consist of a model of some piece of work such as :—

1. Engine room skylight.
2. Cargo port.
3. Bulwarks, wash port and stanchions.
4. Any part of cellular bottom.

The model should be of such dimensions that it will fit into a box not larger than *two* cubic feet.

A Certificate must accompany the work, as stated in the Syllabus of Section A, p. 238.

II. Full Technological Certificate.—For the Full Technological Certificate the Candidate will be required to qualify as stated in Rules 29 and 30.

III. Works of Reference.—“Modern Practice in Shipbuilding, by Thearle. “Practical Shipbuilding,” by Holmes. “Laying-off, Iron, Steel, and Composite Vessels,” by Watson. “Steel Ships,” by Walton. “Manual of Naval Architecture,” by Sir W. H. White. “Theoretical Naval Architecture,” by Attwood. “Text Book of Naval Architecture,” by J. J. Welch (1907). “The Design and Construction of Ships” by Professor J. H. Biles (Griffin).

## 56.—BOILER MAKERS' WORK.

I. Syllabus.—The Examination will include questions founded on such subjects as the following :—

## GRADE I.

1. *Riveting*.—Different forms of rivet heads. Description of the process of cold riveting, hot riveting, and hydraulic and pneumatic riveting. Description of the different forms of joints. Lap joints. Butt joints. Methods of joining plates at the corners, as for instance the throat plate of a locomotive boiler, or the joints at the foundation rings. Simple calculations relating to riveted joints.

2. Methods and tools required for bending plates, for straightening plates, for taking the buckle out of a plate. Punching and drilling plates.

3. General description of and the process of putting together a locomotive boiler, a Lancashire or Cornish boiler, single and double ended Marine boilers. A general knowledge of water tube boilers.

4. Methods of inserting, expanding, and removing the tubes of a locomotive boiler. Caulking.

5. Methods and machines for making, inserting, and removing boiler stays. Roof stays. Methods of making, inserting, and removing the different kinds of roof stays. Girder stays. Sling stays. Direct stays. Longitudinal stays.

6. A knowledge of the arrangements fitted to give access to a boiler for cleaning out. A knowledge of the boiler fittings necessary for the safe working of a boiler. Method of making repairs, such as the renewal of a tube plate, the fixing of a patch. A knowledge of the kind of deterioration which goes on in the different types of boilers.

7. Kinds of joint used in making tanks. Calculation of the capacity of different forms. Methods of attaching inlet and outlet pipes to a tank.

8. A knowledge of the geometrical methods of setting out the patterns and making the templates for a boiler or a tank.

9. Methods of welding angle irons, and bending them to given shapes. Annealing.

10. A general knowledge of the machine tools used in a boiler shop, such as punching and planing machines, edge planing machines, multiple drilling machines, vertical boring machines, machines for tapping fireboxes for stays. Re-heating and annealing furnaces. Hydraulic flanging presses.

11. An elementary knowledge of the physical properties of cast iron, wrought iron, and steel ; elementary notions as to the strength of cylindrical and stayed surfaces.

*All Candidates for Grade I will be required to do a simple piece of mechanical drawing to show that they understand the principles on which such drawings are made.*

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The Examination in both Grades will be held on Thursday, May 2nd, from 7 to 10 p.m. The fee for examination in either Grade is *One Shilling and Sixpence.*

#### FINAL EXAMINATION.

A knowledge will be required of the subjects of the Syllabus for Grade I, together with the following :—

1. Strength of materials used in boiler construction. Strength of cylinders under internal and external pressure. General rules of strength of stays and stayed surfaces.

2. Relative strengths of riveted joints and methods of designing them. Relative advantages of punching and drilling plates. Relative advantages of hand riveting and hydraulic riveting.

3. Construction and jointing of steam pipes for moderate and high pressures. Expansion joints. Methods of testing boilers. Inspection of boilers. Steam pipe connections for boilers worked in groups. Mechanical stoking. Feed water heaters.

4. General knowledge of the thermal efficiencies of different types of boilers ; the consumption of coal per square foot of grate for boilers with chimney draught, and forced draught. Different methods of applying forced draught.

5. General principles and methods of rolling boiler plates, angle irons, and rivet iron. Pneumatic tools.

6. The effects of corrosion on different types of boilers. Water softening apparatus.

7. The regenerative furnace for heating and annealing plates. A knowledge of the machine tools used in a boiler shop. A knowledge of the general equipment of a boiler shop, such as the cranes required, and the hydraulic installation necessary for working the flanging presses.

8. The principles and practice of the design of boilers and furnaces.

9. The use of the oxy-acetylene blowpipe flame for welding and cutting in boiler repairs.

**II. Full Technological Certificate.**—For the Full Technological Certificate the candidate will be required to qualify as stated in Rules 29 and 30.

**III. Works of Reference.**—Stromeyer's "Marine Boiler Management and Construction" (Longmans); Robertson's "Water Tube Boilers" (John Murray); H. de B. Parson's "Steam Boilers: their theory and design" (Longmans, 1903); "Metal Plate Work," by C. T. Millis (Spon); "Practical Sheet and Plate Metal Work," by E. A. Atkins (Whittaker); Fowler's "Steam Boilers" (Scientific Publishing Co.); "Steam Boilers" by R. D. Munro (Griffin); see also List of Books under Mechanical Engineering.

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## 57.—BRICKWORK.

In order to encourage excellence of craftsmanship in this subject, the Institute of Builders offers a First Prize of 30s. and a Silver Medal, and a Second Prize of 20s. and a Bronze Medal, to those candidates who obtain the highest number of marks in the Practical Test, and have previously qualified, or qualify in the same year, for a First Class Certificate in the Final Written Examination.

**I. Syllabus. (1) Written Examination.**—The Examination will include questions founded on such subjects as the following:—

### GRADE I.

1. Brick. The names, nature, and properties of the various kinds of bricks in general use, and the purposes for which each kind is specially fitted. The mode of preparing and tempering the clay, moulding and burning the bricks, and testing their quality.

2. Precautions to be adopted in excavations in various soils. Mode of laying drain pipes.

3. Lime: nature and properties of the different kinds and their use. Cement: method of making and means of testing. Sand: the relative advantages and disadvantages of pit, river, and sea sand. Proportions of the above for making good mortar. Concrete: its ingredients, method of preparation, and uses.

4. Foundations: the width and height of the footings required for walls of different thicknesses. Damp courses, the materials used for these and their practical purpose. Air bricks. The best method of ventilating underground floors. Dry areas, and the method of constructing them and keeping them free from wet.

5. Bond in brickwork. Plans of alternate courses at the angle of walls of different thicknesses, showing English and Flemish bond. Raking bond. Bond at acute and obtuse angles.

6. Brick walls with stone facing. Hollow walls, the methods of constructing and bonding them. Plans of openings in the same.

7. The method of constructing fireplaces, coppers, and ovens, and arrangement of flues. Bond of chimney shafts. Rendering, parging, and coring.

8. Arches. Names of the different kinds and mode of construction. Bond in arches and the description of their several parts, such as soffit, skewback, &c.

9. Paving. Pointing: the comparative merits and demerits of various kinds. Proper composition of black mortar, &c.

10. Tiling. Pantiles, plain tiles, and the method of laying the same and of finishing off the gables, hips, ridges, eaves, &c.

11. The general mechanical principles involved in brickwork, the resistance to crushing, and the average weight per foot cube and per rod.

12. Method of measuring brickwork, tiling, paving, concrete, &c., and the quantities of material required per rod square, &c.

The Written Examination in both Grades will be held on Wednesday, May 1st, from 7 to 10 p.m. The fee for the Written Examination in either Grade is *One Shilling and Sixpence*.

*Candidates for either Grade should be provided with Drawing Instruments. Drawing paper will be supplied, if necessary, by the Institute.*

#### FINAL EXAMINATION.

In the Final Examination more difficult questions will be set in the above subjects, and in addition a knowledge will be required of :—

1. Management of works; rules governing the bonding of brickwork; preparation of specifications.

2. Shoring, underpinning, house drainage, as required to be done by the bricklayer, and sewer construction.

3. Tunnelling, vaulting, the construction of circular and octagonal bays, niches, domes, &c., and drawings to illustrate the same.

4. Setting out intricate bonding in ordinary and in gauged brickwork generally.

5. Terra cotta; its application to buildings.

6. The principal orders and styles of architecture.

(2.) *Practical Examination.*—Candidates who have passed the Written Examination in Brickwork in either Grade *in a previous*

year may present themselves for a Practical Examination in that subject.

Candidates who pass the Practical Examination will have a statement to that effect added to their Certificate for the Written Examination.

The Practical Examination will include the following work :—

1. *Bricklaying*.—(A) Setting out work from architectural drawings. The Candidate must satisfy the Examiners of his ability to set out intricate work, *e.g.*, frontages with awkward breaks, bay windows and other openings ; circular corners, square, obtuse, and acute external angles, irregular shaped rooms, and intersection of walls, &c., first staking out the trenches, and then setting out the neat work.

(B) Building and properly finishing, either with struck, or raked and pointed joint, as desired, any given piece of work, *e.g.*, quoins at any angle, circular corners afterwards brought out to the square, piers, battering walls, fireplaces, chimney shafts, coppers, &c., in red stock, glazed or other description of bricks.

2. *Brickcutting*.—(A) Setting out work in detail from architectural drawings, and obtaining the templets, moulds, &c., *e.g.* arches, moulded and plain, cornices, caps, pediments, pilasters, aprons, and gauged work generally.

(B) Cutting and finishing any required piece of gauged work from templets and moulds supplied.

The Practical Examination will be held in London on **Saturday, May 18th**, provided a sufficient number of Candidates present themselves, and may be held at other times at other centres, where the necessary arrangements can be made.

The additional fee for the Practical Examination will be *Two Shillings and Sixpence*.

The Examination will occupy seven hours, from 1 to 5 p.m., and from 5.30 to 8.30 p.m.

**II. Full Technological Certificate.**—For the Full Technological Certificate, the Candidate will be required to qualify as in Rules 29 and 30, but Certificates showing that he has passed the Examinations of the Board of Education in Geometrical Drawing, as well as in Freehand or Model Drawing, will be accepted in lieu of one of the Science Certificates.

**III. Works of Reference.**—“Bricklaying and Brickcutting” by H. W. Richards (Longmans, Green & Co.); Dobson, E., “Manufacture of Bricks” (Crosby, Lockwood & Son.); Dobson, E., “Foundations and Concrete Works” (Crosby, Lockwood & Son.); Pasley, C. W., “Limes and Cement” (Weale); Burnell, “Limes and Cements” (Crosby, Lockwood & Son.); Reid, “Manufacture of Portland Cement” (Spon.); Baker, “Strength of Arches, &c.” (Spon.); Gwilt, “Equilibrium of Arches” (Weale); “Rivington’s

Notes on Building Construction," 3 vols. (Longmans); Col. Seddon, "Builders' Work" (Rivingtons); Davis, C. T., "Practical Treatise on the Manufacture of Bricks" (Sampson Low); Reid, H., "Practical Treatise on Concrete" (Spon.); Vicat, L. J., "Mortars and Cement," translated by Capt. Smith (Weale); "Drawing for Bricklayers" (Cassells); Stock, C. H., "Shoring and Underpinning" (Batsford); Robson, R., "Masons', Bricklayers', &c., Guide"; "Building Construction," by C. F. Mitchell (Batsford); "Brickwork and Masonry," by C. F. and G. A. Mitchell (Batsford).

## 58.—MASONRY.

In order to encourage excellence of craftsmanship in this subject, the Institute of Builders offers a First Prize of 30s. and a Silver Medal and a Second Prize of 20s. and a Bronze Medal to those candidates who obtain the highest number of marks in the Practical Test and have previously qualified, or qualify in the same year, for a First Class Certificate in the Final Written Examination.

I. Syllabus. (1) Written Examination.—The Examination will include questions founded on such subjects as the following :—

### GRADE I.

1. Stone. Description of the various kinds of building stones and their characteristics. Mode of distinguishing sandstones from limestones. Reasons for preferring one to the other in various climates. Varieties of stone suitable for internal work.

2. Description and explanation of the different stone-cutting tools.

3. Rubble work. Ashlar. Flint work. Bonding stones. Precautions to be adopted in setting stonework. Mode of ascertaining natural bed. Reason why this is important.

4. Precautions to be adopted in excavations in various soils.

5. Lime : Nature and properties of the different kinds and their use. Cement : method of making and means of testing. Sand : the relative advantages and disadvantages of pit, river and sea sand. Proportions of the above for making good mortar. The proper composition of putty and mortar for pointing. Concrete : its ingredients, method of preparation and uses.

6. Foundation : the width and height of the footings required for walls of different thickness. Damp courses, the materials used for these and their practical purposes. The best method of ventilating underground floors. Dry areas, and the method of constructing them and keeping them free from wet.

7. Stone walls with brick backing. Hollow walls, the method of constructing and bonding them. Plans of openings in the same.



8. Quoins, copings, cornices, and mode of hoisting large stones, and precautions to be adopted in setting them. Heads and sills.

9. Mouldings. Names and description ; method of cutting the various mouldings ; joints.

10. The general mechanical principles involved in masonry, the resistance to crushing, and the average weight per foot cube. The method of measuring masonry, and the material required for a given quantity of work.

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The Written Examination in both Grades will be held on Monday, April 29th, from 7 to 10 p.m. The fee for the Written Examination in either Grade is *One Shilling and Sixpence*.

*Candidates for either Grade should be provided with Drawing Instruments. Drawing paper will be supplied, if necessary, by the Institute.*

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#### FINAL EXAMINATION.

In the Final Examination more difficult questions will be set in the above subjects, and in addition a knowledge will be required of :—

1. Management of works, specification writing, &c.

2. Shoring, underpinning, and scaffolding.

3. Full size drawings showing the proper position in various cases of joints, joggles, dovetails, tenons, &c., Geometrical stairs, and the method of setting out the curves.

4. Vaulting, names and description of the various kinds, and method of construction, illustrated by sketches. Flying buttresses, their purpose and mode of construction, spires, &c.

5. Window tracery, generating lines, intersection of mouldings, position of joints, solid angles, &c., circular and octagonal bays, niches, domes, &c.

6. Staircases : general construction and method of support. Landings and means of supporting same when consisting of more than one stone.

7. Arches : names of the different kinds and mode of construction. Bond in arches, and the description of their several parts, such as soffit, voussoir, &c.

8. Terra cotta and its application to buildings.

9. The principal orders and styles of architecture.

(2.) **Practical Examination.**—Candidates who have passed the Written Examination in Masonry in either Grade in a *previous year* may present themselves for a Practical Examination in that subject.

Candidates who pass the Practical Examination will have a statement to that effect added to their Certificate for the Written Examination.

The Practical Examination will include the following work :—

(A) Setting out work in detail from architectural drawings, and obtaining the mould, &c.

(B) Cutting and finishing in any way required, the templets, moulds, &c., being supplied, a specified piece of work, *e.g.*, voussoir of arch, cornice, cap, coping, sill, step, &c.

(C) The Candidate must further satisfy the Examiners of his ability to set out intricate work, *e.g.*, frontages with awkward breaks, bay windows and other openings; circular corners, square, obtuse, and acute external angles, irregular shaped rooms, and intersection of walls, &c., first staking out the trenches, and then setting out the neat work.

The Practical Examination will be held in London on **Saturday, May 11th**, provided a sufficient number of Candidates present themselves, and at other times at other centres where the necessary arrangements can be made.

The additional fee for the Practical Examination will be *Two Shillings and Sixpence*.

The Examination will last seven hours, from 1 to 5, and from 5.30 to 8.30.

**II. Full Technological Certificate.**—For the Full Technological Certificate, the Candidate will be required to qualify as stated in Rules 29 and 30, but Certificates showing that he has passed the Examinations of the Board of Education in Geometrical Drawing as well as in Freehand or Model Drawing, will be accepted in lieu of *one* of the Science Certificates.

**III. Works of Reference.**—Dobson, E., "Masonry and Stone-cutting" (Crosby Lockwood & Son); Dobson, E., "Foundations and Concrete Works" (Crosby Lockwood & Son); Hull, E., "Treatise on Building Stones" (Macmillan); Pasley, C. W., "Limes and Cements" (Weale); Burnell, "Limes and Cements" (Crosby Lockwood & Son); Reid, "Manufacture of Portland Cement" (Spon); Baker, "Strength of Arches, &c." (Spon); Gwilt, "Equilibrium of Arches," (Weale); "Rivington's Notes on Building Construction," 3 vols. (Longmans); "Report of the Commissioners on Stone for the New Houses of Parliament" (Eyre & Spottiswoode); "Report of the Commissioners on the Decay of the Stone of the New Houses of Parliament" (Eyre &

Spottiswoode); Seddon, Col., "Builders' Work" (Rivingtons); Reid, H., "Practical Treatise on Concrete" (Spon); Vicat, L. J., "Mortars and Cement," translated by Capt. Smith (Weale); Stock, C. H., "Shoring and Underpinning" (Batsford); Robson, R., "Masons', Bricklayers', &c., Guide"; "Building Construction," by C. F. Mitchell (Batsford); "Brickwork and Masonry," by C. F. and G. A. Mitchell (Batsford); "Concrete, its use in building," by T. Potter (Batsford); "The Geology of Building Stones," by J. Allen Howe (Arnold).

## 59.—PLASTERERS' WORK.

I.—Syllabus.—The Examination will include questions founded on the following subjects :—

### GRADE I.

1. *Limes*.—Names and qualities of various limes used in Candidate's neighbourhood. Distinction between rich or fat limes, and poor or lean limes. Distinction between hydraulic and non-hydraulic lime. Methods of testing mortars. Methods of slaking various limes. Purpose for which each variety is best fitted. Methods of making lime mortar for various purposes.

2. *Sand*.—Various qualities of. Proportions of admixture for various limes and cements. Substitutes for sand. Aggregates for Portland cement and artificial stone.

3. *Hair*.—Use of, and method of preparing wet and dry hair. Antiseptic plaster fibre.

4. *Stucco*.—Mixing, tempering, and manipulating; common, rough, bastard, trowelled, and coloured stuccos for internal and external use.

5. *Rough Cast*.—Materials, quantities and method for plain and coloured rough cast. Distinction between rough cast and depeter.

6. *Lime Plaster Substitutes*.—Mode of gauging and using Adamant, Asbestic, Granite, Keen's, Martin's, Parian, Robinson's, Selenitic, Sirapite Express plaster. Purposes for which each variety is best fitted.

7. *Plaster of Paris*.—Mineralogical nature, whence obtained and how prepared. Distinction between coarse, fine, and superfine, and special use for each quality. Its influence on lime, stucco, and mortar by admixture.

8. *Moulding and Casting*.—Moulding in plaster, wax, gelatine, sulphur, and Phelp's metal. Reverse moulds. Preparation and indurating of moulds for casting plaster, white cements, composition, carton-pierre. Portland and Roman cements. Trimming, keying, and jointing cast work. Fibrous plaster; its preparation and uses.

9. *Lathing*.—Size and quality of wood laths, and lath nails. Metal lathing for fire-proof construction.

10. *Cements*.—Natural and artificial. Character of cements for internal and external use. Mode of testing, gauging and using Portland, Roman, Medina, Sheppy, Waterproof, and Slag cements.

11. *Plastering*.—Rendering, floating, and setting. Running and mitreing mouldings and fixing ornament. Fixing fibrous plaster. Preparing brick and stone walls for plaster work. Concrete work.

12. *Tools and Appliances*.—Tools used for shop work, modelling, building work, and concrete.

The Examination in Grade I will be held on Tuesday, April 30th, 7 to 10 p.m. The fee for the Examination in Grade I is *One Shilling*.

#### FINAL EXAMINATION.

Candidates for the Final Examination will be required to pass a Written Examination, and to produce examples of their practical work.

(1.) *Written Examination*.—The Written Examination may include more difficult questions on the subjects of Grade I, and in addition a knowledge will be required of such subjects as the following :—

1. *Plastering*.—Tests and analyses for limes, plaster, and cements. Causes of hydraulicity of certain limes, and methods of imparting hydraulicity to limes not possessing it. Quantities of materials for covering a given area. Setting out panelled ceilings and walls for solid and fibrous plaster, and cement work. Plastering plain and fluted columns and pilasters with an entasis on brick or lath core. Running oval moulding to a given size. Forming oval mouldings. Method of forming returned and break mitres. Laying pugging. Forming Pediments. Measuring plaster work.

2. *Shop Work*.—Waste moulding in plaster and wax. Plaster piece moulding from high relief and from the round. Running plaster piece moulds. Piece moulding in plaster, wax, and sulphur. Moulding from life. Scagliola making and polishing. Gesso, composition, carton-pierre, fibrous plaster, plain face, and fibrous slabs. Moulding and casting, model making.

3. *Modelling*.—Modelling in clay, plaster, stucco, gesso, and cement for internal and external work.

Description and drawings of observed examples of work in Candidate's own neighbourhood or elsewhere.

4. *Sgraffito*.—Description of materials (with proportion of quantities), and method of manipulation. Pouncing, cutting and clearing out. Methods employed for work done *in situ* and on slabs.

(2.) *Specimen Work*.—The Candidate will also be required to execute during the year preceding the Examination, and to forward

the same to London (carriage paid) on, or before, April 29th, an original specimen of his work, which shall not exceed 3' x 3' x 1' in dimensions.

The Specimen may be an example of :—

- 1.—Piece moulding with cast from same and seams not cleaned off.
- 2.—Casts from modelled Clay, not cleaned up.
- 3.—Modelled Stucco.
- 4.—Modelled Cement.
- 5.—Sgraffito Work.
- 6.—Models of Panelled Ceilings, Columns, Pilasters, Pediments, Cornices.
- 7.—Plastered Slabs (in wood frames) of lime, stucco, Portland cement, Keen's or other white cements, showing lath and the various coats of the material used.

Drawings by Candidates of old ornamental work in stucco, with name of place where found, may be forwarded with specimens of practical work, and will be considered in the award of prizes.

A Certificate signed by the Candidate's employer or by the Class Teacher and a member of the School Committee, stating that the work has been executed by the Candidate himself, without assistance, *must be forwarded with the specimen*. In cases where the work has been executed at the Candidate's own residence, a Statutory Declaration will be required. Forms for either the Certificate or Declaration may be obtained on application to the Institute.

The Final Written Examination will be held on Tuesday, April 30th, from 7 to 10 p.m. The fee for the entire Examination is *Two Shillings and Sixpence*.

**II. Full Technological Certificate.**—For the Full Technological Certificate, Candidates will be required to have passed the Final Examination, to have also passed the Examinations of the Board of Education in Freehand Drawing, and to give evidence of having satisfactorily attended a course of instruction in Elementary Modelling at an Art or Technical School.

**III. Works of Reference.**—Rivington's "Notes on Building Construction," Parts II. and III. (Longmans); G. R. Burnell's "Limes, Cements and Mortars" (Weale's Rudimentary Series, Crosby Lockwood & Son, 1887); "Portland Cement," H. Reid (Spon); "Every-day uses of Portland Cement," published by the Associated Portland Cement Manufacturers; Bankarts "Art of the Plasterer"; "Plastering," by Alexander Kemp (Weale); "Plastering, Plain and Decorative," by W. Millar (Batsford); "Concrete, its use in Building," by T. Potter (Batsford); "Angel's Geometry," 2 vols. (Batsford); "How to Estimate," by J. T. Rea (Batsford); "Reinforced Concrete," by Marsh; "The Chemistry and Testing of Cement," by C. H. Desch (Arnold).

Prizes varying in value from £8 to £1 are offered by the Worshipful Company of Plasterers on the results of the Examinations. (*See Prize List, p. 236.*)

## 60.—PAINTERS' AND DECORATORS' WORK.

The course of instruction should cover a period of at least three years.

With the view of encouraging apprentices to take the complete course of instruction in this subject, the examinations will be held in three grades of which Grade I will be of an elementary character. No certificates will be given to candidates on the results of the examination in Grade I, but their successes will be notified to the centre at which they were examined. Candidates may take the examination in Grade II without having passed in Grade I, or both examinations may be taken in the same year.

It is advisable that apprentices should attend at least a year's course of instruction before presenting themselves for the Examination in Grade I.

*N.B.*—The practical test must be taken in the grade corresponding to the written examination.

### I. Syllabus.—

#### GRADE I.

The Examination in Grade I will consist of a written paper only which will include questions founded on such subjects as the following :—

1. *Drawing.*—Freehand drawing from copies, objects and memory ; simple constructive geometry ; the use of plain scales.

2. *Mensuration.*—The measurement of simple areas as required by painters or paperhangers. Weights and measures used for painters' materials.

3. *General Principles.*—Terms used in painting ; object in painting surfaces ; the principles underlying the use of paints.

4. *Colouring.*—Mixing simple colours ; the elements of colour theory ; simple facts about the use of colour in practice.

5. *Brushes, Tools, Plant and Appliances.*—The names, description and uses of brushes and other tools ; the care and preservation of brushes, tools and appliances.

6. *Materials.*—The principal pigments, thinners and driers used in painting ; their uses and distinctive qualities ; varnishes, their classification and uses.

7. *Grounds for Painting.*—The necessity of varying the ingredients of paint according to the ground to which it is to be applied ; stopping, filling up and surfacing ; paint removal.

8. *Painting.*—The simple mixing of paints ; the application of paints and the best method of painting various kinds of surfaces.

9. *Distemper*.—The preparation of grounds, the composition and application of distemper, and the removal of old distemper.

10. *Wall-hangings*.—The dimensions of paper hangings; the preparation of pastes and other adhesives; the preparation of walls; the stripping and hanging of ordinary papers.

11. *Imitative Painting*.—The preparation of grounds and the colours used for woods; the difference in the grain of wood according to the way it is cut.

12. *Sign Writing and Lettering*.—The principal styles of lettering and their forms and names; setting out of simple signs; the punctuation of signs.

13. *Decorative Processes*.—Elements of stencils and stencilling.

14. *Varnishing*.—Preparation for varnishing; applying varnish, felting down and polishing.

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The Examination will be held on Monday, April 29th, from 7 to 10 p.m. The fee for the examination is *One Shilling*.

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The examination in Grade II and the Final Examination will each consist of a written examination and a practical test.

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## GRADE II.

(1.) *Written Examination*.—The written examination will include questions on such subjects as the following, in addition to more difficult questions on the subjects Syllabus for Grade I.

1. *Drawing*.—Freehand from copies, objects and memory; geometrical construction of patterns; freehand sketches illustrating the principal parts of buildings and fittings, forms and mouldings, cornices, architraves, etc.

2. *Architectural*.—The architectural signification of plinths, cornices, corbels, architraves, string courses and similar features and their consequent colour and treatment.

3. *Mensuration*.—Methods of measuring for painted work, and for paper and other hangings.

4. *General Principles*.—The preservative, hygienic and decorative aspects of painters' work; economy in working; cleanliness in working.

5. *Colouring*.—The laws governing the use of colours ; matching and combining colours ; contrast, analogy, and mutual relationship of colours ; classification and nomenclature of colours ; hues, tints, shades, tones, broken colour, &c.

6. *Brushes, Tools, Plant and Appliances*.—The composition of, and the material used in painters' brushes ; the characteristics of a good brush ; the use of plant and appliances.

7. *Materials*.—Oils and diluents, their properties, distinctive qualities and uses ; driers, siccatives, their composition, nature and action ; pigments, comparative value as painters' materials, permanence and fugacity of pigments ; oils, durability and stability ; varnishes, their constituents and nature.

8. *Grounds for Painting*.—Dampness and its treatment ; faulty woods, knots, sap, &c., and their corrections ; blisters and blistering and their prevention and cure ; cement and plaster grounds and their treatment. External iron and steel, priming and painting.

9. *Painting*.—Faults in painting and their avoidance ; the preparation of ingredients in oil paint, flattening, enamelling, japanning, &c. ; colours that may not be mixed with one another.

10. *Distemper*.—Washable and other distempers ; colours affected by lime ; patent tempera and water paints ; stencilling and lining on distemper ; limitations of distemper.

11. *Wall-hangings*.—Varieties and makes of wall papers and other hangings. Selection of papers for walls and ceilings ; setting out for and hanging relieve materials.

12. *Imitative Painting*.—The artistic use of graining, marbling and gilding ; colours for and methods of working graining of different woods ; marbling and graniting.

13. *Sign Writing and Lettering*.—The principles governing sign, notice and advertising lettering ; the ornamentation, elaboration and emphasising of lettering ; punctuation, spelling and styles.

14. *Decorative Processes* — Striping, lining and outlining ; designing and cutting stencils and stencilling ; gilding ; painting in monochrome light and shade and in polychrome ; glazing, scumbling and the production of broken colour grounds.

15. *Staining Woods*.—Wood suitable for staining ; preparation and application of stains ; ornamental and decorative staining ; oiling and polishing.

16. *Varnishing*.—Faults in varnish and varnishing and their prevention and cure ; flattening and encaustic varnishing ; selection and application of varnish.

(2.) *Practical Examination*.—The Practical examination will consist of two exercises in practical work selected from the following



subjects and set for execution within a given time prior to the written examination.

- (a.) Preparation and plain painting.
- (b.) Selection and arrangement of colours.
- (c.) Enamelling and varnishing.
- (d.) Stencil cutting and stencilling.
- (e.) Plain or ornamental lettering.
- (f.) Simple decoration in oil or distemper.
- (g.) Graining or marbling.

(For dates, and particulars of the certificates required to be forwarded with practical work, *see* p. 260.)

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The Written Examination in Grade II and the Final Written Examination will be held on Tuesday, April 30th, from 7 to 10 p.m. The fee for Examination in either Grade is *Two Shillings and Sixpence*.

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#### FINAL EXAMINATION.

*Candidates for the Final Examination must hold a Certificate in Grade II.*

(1.) The Written Examination will comprise advanced questions on any of the subjects included under the two previous examinations, together with the following :—

1. *Drawing*.—The preparation of decorative designs ; the preparation of working drawings from scale designs ; the designing of ornament.

2. *Architectural*.—The orders and styles of architecture and their predominant features.

3. *Mensuration*.—Estimating and taking out quantities for painters' work.

4. *General Principles*.—The management of men and works ; the specification of treatment for given purposes and under given conditions.

5. *Colouring*.—Colour in historic ornament ; arrangement and selection of colour schemes ; chromatic analysis ; abstract qualities of colour in decoration ; colour and lighting, artificial and otherwise.

6. *Brushes, Tools, Plant and Appliances*.—The management of the paint shop and stores ; the selection of plant and tools for jobs ; the testing of steps, ladders, etc. ; the arrangement of scaffolding for painters.

7. *Materials*.—Testing colours, pigments, oils, turpentine and driers ; the selection and purchase of materials ; the quantity of materials for given work.

8. *Grounds for Painting*.—Preparation for special grounds as copper, iron, cement, etc. ; the treatment for special conditions, as smoke, grease, heat, frost, hard wear.

9. *Painting*.—Testing of paints to ascertain power to resist action of weather, heat, gases, etc. ; action of successive coats of paint upon preceding coats and arrangement of sequences ; arrangement of men when painting large surfaces.

10. *Distemper*.—Painting ornament in and gilding on distemper ; the use of distemper on other than plaster grounds.

11. *Wall Hangings*.—Decorating relief materials in metal and colour ; hanging jute, canvas, silk, tapestry, etc. ; the selection of hangings.

12. *Imitative Painting*.—The use of imitative effects of material and texture, as bronze, ivory, majolica, etc. ; roller and transfer processes of graining ; the representation of inlays, marqueterie, mosaic, ivory, bronze, etc.

13. *Sign Writing*.—Writing and embossing, gilding and colouring on glass ; heraldic painting and illuminating.

14. *Decorative Processes*.—Polychromatic stencilling ; raised and sanded decorative painting ; matt and burnish gilding ; gesso painting ; tapestry painting.

15. *Staining*.—Chemical staining ; preparation of stains ; comparative value of water, oil and spirit staining for different woods and colours.

16. *Varnishing*.—Testing, purchase of, and storing, and ageing of varnishes.

(2.) The Practical Examination will consist of two exercises in practical work selected from any of the following subjects and set for execution by the student within a given time prior to the date of the written examination.

(a.) The preparation of a design for decoration.

(b.) The preparation of full size working drawings and partial execution in colour from a scale black and white sketch.

(c.) The arrangement and execution of a decorative sign board in colour and gold.

(d.) The painting and stencilling of a panel or frieze, from given directions.

(e.) The execution of not less than three examples of specified woods or marbles.

(f.) The execution of a panel decorated by one of the processes included in the syllabus for the written examination and specified by the examiners.

(g.) The matching and harmonising of named colours, tints or shades upon a moulded panel and the finish of the panel in varnish, or other specified manner.

(h.) The painting of ornament in monochrome from a cast.

Particulars of the exercises selected for the Practical Examinations in both Grades will be forwarded so as to reach the Secretary of every registered class and other applicants on **Saturday, January 27th**, and the Candidates' prepared work must be forwarded to London on or before **Thursday, March 28th**.

A Certificate signed by the Candidate's employer or by the Class Teacher and a member of the School Committee, stating that the work has been executed by the Candidate himself, without assistance, *must be forwarded with the specimen*. In cases where the work has been executed at the Candidate's own residence, a Statutory Declaration will be required. Forms for either the Certificate or Declaration may be obtained on application.

**II. Full Technological Certificate.**—For the Full Technological Certificate, Candidates will be required to qualify as stated in Rules 29 and 30, or to have passed the Final Examination, and also to have passed the Examinations of the Board of Education in Freehand Drawing, and in Principles of Ornament, or Painting Ornament in Monochrome.

**III. Works of Reference.**—"Colour," by Professor Church, 3s. (Cassell, London). "Painting and Decorating," by Pearce, 12s. 6d. (Griffin & Co., London). "Alphabets," by Lewis F. Day, 3s. 6d. (Batsford, London). "Lectures on House Painting" (Painter Stainers Co., Painters' Hall). "Chemistry of Paints and Painting," by Church (Seeley & Co.). Painters' Colours, Oils and Varnishes, by Hurst (Griffin). "Ornament and its Application" and "Nature and Ornament," by L. F. Day (Batsford). "Practical Gilding and Stencilling," by Mitchell. "Practical Church Decoration," by Duthie. "Wall Paper Decoration," by Jennings. "Paint and Colour Mixing," by Jennings (Trade Papers Publishing Co., London). "Heraldry," by G. W. Eve (Batsford). "Alphabets," by Strange (Bell). "Art of Graining and Marbling" (Sutherland). "Graining," by Petrie (Office of "Decorator"). "Ideals in Art" and "Line and Form," by Walter Crane (Bell). "Concise Glossary of Architecture," by Parker (Batsford). "Grammar of Ornament," by Owen Jones. "The Studio Year Books of Decorative Art." *Periodicals.*—"The Decorators' and Painters' Magazine" (London). "The Decorator" (London). "The Journal of Decorative Art" (Manchester). "The Plumber and Decorator" (London). *Reference Periodical.*—"The Studio."

## 61.—MILLING (FLOUR MANUFACTURE).

With a view of encouraging young men engaged in Flour Mills to obtain the necessary technical training to enable them to pass the Institute's Examination in Flour Milling, the Incorporated National Association of British and Irish Millers offers the following prizes on the results of the Institute's Examinations :—

A Gold Medal of the value of Five Guineas to the Candidate, who having obtained the First Prize in the Institute's Final Examination, writes a paper of sufficient merit on any subject to be specified, within six months after the Examination. The paper to be forwarded to the Secretary of the Association and marked "Essay." Should the Essay not be considered to have reached the standard for the Gold Medal, a Silver Medal may be awarded instead.

A prize of Two Guineas to the Candidate obtaining the First Prize at the Institute's Final Examination.

A prize of £5 to any Candidate who obtains the Institute's Full Technological Certificate.

A Silver Medal and a prize of Two Guineas to the Candidate who obtains the First Prize at the Institute's Examination in Grade I.

To all Candidates who pass First Class in the Final Examination, prizes to the value of Fifteen Shillings; and to those who pass First Class in Grade I, prizes to the value of Ten shillings will be awarded.

To all Candidates who pass Second Class in either examination, prizes to the value of Five Shillings.

Any Candidate who has made at least twenty attendances at a registered class, and has given evidence of diligence and attention, will receive a prize to the value of Three Shillings and Sixpence, even although he may not have succeeded in passing the Institute's Examination.

For further particulars apply to the Secretary of the Association, 59, Mark Lane, E.C.

I. Syllabus.—The Course of Instruction in this subject is intended to cover a period of *at least* two years. The Examination will include questions founded on such subjects as the following :—

## GRADE I.

1. Structure and composition of the wheat berry.
2. The varieties of native and foreign wheats; their characteristic qualities; the light grain and extraneous matter to be found mingled with each sort.

3. The cleaning and conditioning of wheat. Machines and processes in use. The handling and disposal of matter extracted.

4. Roller mills, and their handling. Principles of construction, speeds, differentials, grooving, application of pressure, driving, lubricating, exhausting, etc.

5. Scalping, grading and flour dressing. Machines used, and their handling. Principles of construction, clothing, speeds, driving, etc.

6. Purification. Machines used, and their handling. Principles of construction, clothing, etc.

7. Transmission of power, elevators, conveyors, lifts, hoisting tackle, dust-collecting apparatus, and all appliances needed in a flour mill.

8. The storing of wheat and manufactured products.

9. The testing of flour.

The Examination in both Grades will be held on **Saturday, May 4th**, from 2.30 to 6.30 p.m. The fee for the Examination in either Grade is *One Shilling and Sixpence*.

#### FINAL EXAMINATION.

In the Final Examination more difficult questions will be set in the foregoing subjects, and, in addition, a knowledge may be required of :—

1. Wheat mixtures, and mixing. Combinations of wheats requisite to produce flours of certain defined qualities.

2. The designing of flow sheets, complete or sectional.

3. The preparation of products for sale. Flour dividing and blending. Offal sorting.

4. The handling for flour milling of power producing plants. Power required to operate any machine, or set of machines.

5. Lighting and ventilation of flour mills, their protection from fire and explosion.

6. Planning, construction, and equipment of mill buildings, warehouses and silo houses. Labour-saving appliances.

7. Mill managers' work. Keeping of mill records. Percentages, etc. Costs of production. Insurances.

8. Application of technical knowledge to the commercial side of the business.

To obtain a First Class Certificate in the Final Examination,

knowledge of the subjects included in the Sections 6 to 8 of the syllabus for the Final Examination in addition to the other subjects.

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II. Full Technological Certificate.—For the Full Technological Certificate, the Candidate will be required to qualify as stated in Rules 29 and 30.

III. Works of Reference.—“The Miller” and “Miller’s Gazette and Corn Trade Journal” and “Milling” (Liverpool); the various American, German and French periodicals devoted to corn milling; Professor Kick’s “Die Mehlfabrikation”; Gustav Pappenheim, “Populäres Lehrbuch der Müllerei”; Millfurnishers’ Catalogues and Pamphlets; Jago’s “Chemistry of Wheat, Flour and Bread”; “Modern Flour Milling,” by William R. Voller; “The Roller Mill and Silo Manual,” by James Donaldson; Halliwell’s “The Technics of Flour Milling.”

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## 62.—CABINET-MAKING.

I. Syllabus.—The Examination will include questions founded on such subjects as the following:—

### GRADE I.

1. The nature and properties of the various kinds of wood used in cabinet making, with the ports or places from which they are obtained.

2. The most suitable woods for construction. Groundwork and veneers; the best methods of seasoning and preparing for their various uses.

3. Cabinet-making tools: their different uses. The economy and advantages of wood-working machinery.

4. Plain jointing, cooper joints, dowelling, tonguing, dovetailing.

5. Plane and solid geometry as applied to cabinet-making. The preparation of plans, elevation and section from small scale drawings.

6. The descriptions and names of different parts of pieces of furniture, such as pilaster, capital, frieze, plinth, base, surbase, etc.; also of mouldings. Freehand lines for brackets and mouldings. Modes of building circular rims; curved panels.

7. Veneering on flat and shaped work. Various appliances for veneering. Preparation of grounds and veneers, and the best methods of making work stand after veneering.

8. Cabinet brasswork, hinges, joint stays, bolts and locks. The best methods of fixing, and their different advantages.

The Examination in Grade I will be held on Tuesday, April 30th, 7 to 10 p.m. The fee for the Examination is *One Shilling*.

#### FINAL EXAMINATION.

*Candidates for the Final Examination will be required to pass a Written Examination, and also to produce specimens of drawing and practical work.*

(1.) **Written Examination.**—The Examination will include advanced questions on some of the preceding subjects, and in addition a knowledge will be required of:—

1. Principles and proportions in designing furniture with regard to its use and the material employed.

2. Mechanical actions such as are used in cylinder fall desks, writing tables, dumb waiters, &c.; the different methods of expanding dining tables.

3. Inlaying and veneering with tortoiseshell, ivory, mother-of-pearl, and metals. The preparation and best methods of applying veneers to flat and sweep work.

4. The different styles of furniture and the periods to which they belong.

(2.) **Specimen Work.**—Each candidate will be required, during the year preceding the Examination, to design and execute a piece of work and to forward the same to London (carriage paid) on or before April 29th. The work must be accompanied by a working drawing showing the construction and must not exceed 18 by 12 by 12 inches.

The specimen may be an example of construction, veneering or inlaying, or it may comprise all three.

Each candidate will also be required to forward at the same time a working drawing of a piece of cabinet-work in which the details are original, and the work specially designed for its use. No ornaments or mouldings to be introduced except such as are absolutely necessary for the construction or the outcome of the materials used.

A Certificate signed by the Candidate's employer or by the Class Teacher and a member of the School Committee, stating that the work has been executed by the Candidate himself, without assistance, *must be forwarded with both the Drawing and the Specimen work*. In cases where the work has been executed at the Candidate's own residence, a Statutory Declaration will be required. Forms for either the Certificate or the Declaration may be obtained

The Final Written Examination will be held on Tuesday, April 30th, from 7 to 10 p.m.

The fee for the entire Final Examination is *Two Shillings and Sixpence*.

**II. Full Technological Certificate.**—For the Full Technological Certificate, Candidates will be required to have passed the Final Examination, and to have also passed the Examinations of the Board of Education in Geometrical Drawing, Freehand Drawing and Model Drawing.

**III. Works of Reference.**—"Specimens of Ancient Furniture," by H. Shaw, F.S.A. (B. T. Batsford, 94, High Holborn); "Cabinet Makers' Drawing Book," by Thomas Sheraton (B. T. Batsford, 94, High Holborn); "Cabinet Makers' Assistant" (Blackie & Son, Edinburgh and London); "London Book of Prices" (Secretary Cabinet Makers' Society, "Wheatsheaf," Rathbone Place, Oxford Street, W.); "History of Furniture," by Litchfield (Truelove and Shirley, 113, Oxford Street, W.); "Ancient and Modern Furniture," by Hungerford Pollen (Chapman & Hall, 11, Henrietta Street, Covent Garden, W.C.); "Furniture and Decoration," by John Aldam Heaton (B. T. Batsford, 94, High Holborn); "Dictionnaire de l'Ameublement," par Henry Havard (Maison Quainton, 7, Rue St. Benoît, Paris); "Cabinet Maker and Art Furnisher," by J. Williams Benn (Christopher Street, Finsbury Square, E.C.); "Hepplewhite's Cabinet Maker and Upholsterer's Guide" (Batsford); "Chippendale Cabinet Maker's Director" (Batsford). "Recueil de Décorations Intérieures," Percier et Fontaine (Paris), 1812; "18th Century Furniture," by A. T. Strange (London); "French Interior, &c., during 17th and 18th Centuries," by A. T. Strange (London); "Intarsia and Marquetry," by F. Hamilton Jackson (Sands and Co.); "Gothic Furniture in Style of 15th Century," by A. W. N. Pugin (1835); "Gothic Forms applied to Furniture," by Bruce J. Talbert (1867); "Examples of Ancient and Modern Furniture," by Bruce J. Talbert (1867); "Hints in Household Taste in Furniture," by C. L. Eastlake (1872); "Sketches of Artistic Furniture," by Collinson and Lock (1871); "Art Furniture," by E. W. Godwin (1877); "Furniture," by W. Burges (1864); "Mansions of England," by Nash; "English Furniture of the 18th Century" by Herbert Cescinsky (George Sadler & Co., 207A Borough High Street); "Modern Cabinet Work, Furniture and Fitments" by P. A. Wells and J. Hooper (B. T. Batsford); "The Age of Oak, Walnut, Mahogany and Satinwood" by Percy Macquoid.

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### 63.—BOOKBINDING.

With a view to encourage apprentices to pursue their studies at a Technical School whether the apprentices are regularly indentured or not, provided they are under 21 years of age and have



been working as learners at the Bookbinding Trade for a period of at least two years, the Worshipful Company of Stationers offer a Prize of Three Guineas and a Silver Medal in each section, Forwarding and Finishing, to the apprentice or learner who passes the Institute's Examination in the First Class of Grade I and obtains the highest number of marks among qualified candidates. In the award of these Prizes preference will be given to candidates working or residing within a radius of 20 miles of Stationers' Hall.

**I. Syllabus.**—The Examination will consist of two parts—A. Forwarding; and B. Finishing. Candidates cannot be examined in both parts in the same year.

The Examination in either part will be both Practical and Written.

The Examination will be held at any School supplied with the necessary tools and appliances, or at any centre at which arrangements can be made for the loan of a bookbinder's shop.

The Written Examination in both Sections of Grade I and of the Final Examination will be held on Tuesday, April 30th, from 7 to 10 p.m.

The Practical Examination in "Forwarding" in both grades will be held on Friday, May 10th, from 6 to 10 p.m., and on Saturday, May 11th, from 2.30 to 6.30 p.m.

The Practical Examination in "Finishing" in both grades will be held on Saturday, May 4th, from 2.30 to 6.30 p.m.

The Fee for the Written and Practical Examinations in either Grade, and in either section, is *Three Shillings and Sixpence*.

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## A.—FORWARDING.

### GRADE I.

(1.) **Written Examination.**—The Written Examination in Grade I will include questions founded on the following subjects:—

1. Sizes and quality of paper, boards, and books.
2. Glue, paste, their preparation and use.
3. Folding, refolding, pulling to pieces.
4. End papers, their use, various styles, and how to make them.
5. Preparing for sewing, the methods of sewing and marking up different styles of sewing.
6. Preparation of boards, glueing up, rounding, backing, drawing in, and pressing.
7. Cutting in and out board, different methods employed.
8. Styles of edge decoration, materials used, sprinkling, marbling,

9. Headbanding, lining up, and preparing for covering.
10. Materials used in covering books and methods of working.
11. Siding and pasting down.
12. Tools used in forwarding.
13. Cost of cloth and half leather binding.

(2.) **Practical Examination.**—Candidates will be expected to show proficiency in any two of the following operations :—

Pulling to pieces, sewing, folding, making end papers, rounding, backing, cutting in boards, lining up, covering (cloth and half-bound), siding and pasting down.

Sheets or Books are provided by the Institute for each Candidate, but presses and all appliances for Forwarding must be provided by the School.

#### FINAL EXAMINATION.

*Candidates for the Final Examination are required to hold a Certificate in Grade I.*

(1.) **Written Examination.**—The Final Examination may include more difficult questions in the above subjects, and in addition a knowledge will be required of :—

1. Restoration of paper of Old Books and MSS., causes of stains, and methods of removing.
2. Use of paper splitting, map mounting, plate inlaying, interleaving, and guarding (linen), and how done.
3. End papers and joints, silk end papers, silk and leather doublures.
4. Flexible work, worked headbands.
5. Colours used in edge decoration ; edge gilding.
6. Workshop equipment and organisation.
7. Cost of materials used by bookbinders.
8. Cost of different styles of binding.

Candidates for the Final Examination will be expected to be able to work out in detail estimates for any given work showing the time and materials needed and their cost.

(2.) **Practical Examination.**—Candidates will be expected to show proficiency in any two of the following operations ;—

1. Washing and sizing, and staining.
2. Making and putting in a morocco joint.
3. Forwarding a flexible book.
4. Covering a whole-bound morocco book and generally to show knowledge of extra forwarding

Sheets or books are provided by the Institute for each Candidate, but presses and all appliances for Forwarding must be provided by the School.

(3.) **Specimen Work.**—Candidates for the Final Examination will also be required to submit a specimen of their work done in the twelve months previous to Examination, which must be forwarded to the Institute not later than April 29th.

A Certificate signed by the Candidate's employer or by the Class Teacher and a member of the School Committee, stating that the work has been executed by the Candidate himself, without assistance, *must be forwarded with the specimen*. In cases where the work has been executed at the Candidate's own residence, a Statutory Declaration will be required. Forms for either the Certificate or the Declaration may be obtained on application to the Institute.

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## B.—FINISHING.

### GRADE I.

(1.) **Written Examination.**—The Written Examination in Grade I will include questions founded on the following subjects :—

1. Names and qualities of the various leathers used in covering books.
2. Ordinary materials used in covering books, other than leather.
3. Names of tools, and their respective applications in finishing the back of a book.
4. Paste, paste-water, size, vinegar, and glair ; their preparation, mixture, and effect on the various leathers.
5. Marking-up, and methods of preparing for finishing the backs of half-bound books with bands.
6. Successive operations in "tooling."
7. Blocking.
8. General rules for arranging the lines of lettering.
9. Designing simple arrangements of tools for the backs of half-bound books.
10. Methods in cleaning off the gold after the tooling.
11. The pressing and "finishing out" of a half-calf, and half morocco book, plain or polished.

(2.) **Practical Examination.**—Candidates may be required to show proficiency in any two of the following processes :—

1. Finishing a half-calf back (five bands), with one or two lettering pieces in a "neat" style—

*a.* The preparation not to show on the calf.

*b.* To be polished all over.

2. Finishing a half-calf gilt run-up back.

3. Finishing a half-calf back with plain two or three line mitred panels, and single-line mitre round lettering pieces—

*a.* The preparation not to show on the calf.

*b.* To be polished all over.

4. Finishing a half-morocco back, the preparation not to show in any case.

Wood blocks with leather covered backs, or leather covered boards, will be supplied by the Institute for each Candidate but all Finishing tools and letters must be provided by the School.

#### FINAL EXAMINATION.

*Candidates for the Final Examination are required to hold a Certificate in Grade I.*

(1.) **Written Examination.**—The Final Examination may include more difficult questions on the subjects of Grade I, and in addition a knowledge will be required of :—

1. Methods of preparing for finishing—

Calf.

Morocco.

Pig skin.

Sheep skin.

Seal skin.

2. Designing backs, sides, and lettering panels for hand tooling.

3. Cost of finishing materials and tools.

4. Equipment and organization of finishing shop.

Candidates will be expected to be able to work out in detail estimates for any given work, showing the time and materials needed and their cost.

(2.) **Practical Examination.**—Candidates may be required to show proficiency in any branch of extra finishing and simple designing.

Wood blocks with leather covered backs, or leather covered boards, will be supplied by the Institute for each Candidate, but all Finishing tools and letters must be provided by the School.

(3.) **Specimen Work.**—Candidates for the Final Examination will also be required to submit a specimen of their work and the working drawing, done in the twelve months previous to Examination, which must be forwarded to the Institute not later than April 29th.

A Certificate signed by the Candidate's employer or by the Class Teacher and a member of the School Committee, stating that the work has been executed by the Candidate himself, without assistance, *must be forwarded with the specimen*. In cases where the work has been executed at the Candidate's own residence, a Statutory Declaration will be required. Forms for either the Certificate or the Declaration may be obtained on application to the Institute.

**II. Full Technological Certificate.**—For the Full Technological Certificate, Candidates will be required to have passed the Final Examination, and to have also passed the Examination of the Board of Education in Freehand Drawing.

**III. Works of Reference.**—"The Art of Bookbinding," Zaehnsdorf (Bell & Sons); "Bookbinding, and the Care of Books," by Douglas Cockerell (John Hogg); Report of the Committee of the Society of Arts on Leather for Bookbinding (Bell & Sons); any current price lists of Bookbinding Materials and appliances.

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#### 64.—DRESSMAKING.\*

The Examination will be Practical and Written, and will be so arranged as to test the Candidate's skill in Cutting-out, in Fitting, and in Dressmaking.

The fee for the Examination is *Two Shillings and Sixpence* for Candidates who have made at least 20 attendances at a class registered by the Institute (see Rule 2) during the Session preceding the Examination, and *Seven Shillings* for other Candidates. Only students who have regularly attended a registered class are eligible for prizes.

The Examination will include—(1) Practical Examination; (2) Written answers to questions, and drawing; (3) Specimen work done by the Candidate in class or in her own home.

To obtain a Certificate, Candidates will be required to pass in each of the parts 1, 2, and 3.

(1.) **Practical Examination.**—Each Candidate will be required to draft, cut out, and tack a bodice lining or a blouse from given measurements, with one sleeve tacked in, and to work any section of a bodice or skirt which may be indicated at the time of the

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\* It should be noted that Rules 1 to 7, for the Registration of Classes, are all applicable to Subjects 64, 65, 66, 67 and 75.

Examination ; for instance, preparing fronts for button-holes and buttons, or working button-holes, or making a collar, or facing sleeves and basques, or arranging a placket and pocket, or binding a skirt, etc. The materials will be supplied by the Institute.

No Charts, curved rulers, or specially graduated rules of any kind may be used during the Examination.

Candidates will be required to bring with them to the Practical Examination a tape measure, a ruler, pencil or chalk, a tracing wheel, a thimble, scissors, pins, needles, suitable cottons, and silk (any colour) for button-holing.

(2.) The Written Examination will include questions on the following subjects :—

1. The different parts of a dress-bodice, including the sleeve and collar : how put together and how finished off.

2. The linings most suitable for such materials as *Velvet*, *Serge*, and *Silk*, and the points to be noted in tacking linings to these materials.

3. Calculation of quantity of material of various widths required for a dress, and cost of dress, including material, lining, making and finishing.

4. Methods of fastening a dress ; the use of whalebones in dress-bodices, and substitutes therefor.

5. The various stitches and processes of work used in dressmaking and their application to the material.

6. Drafting of diagram of a plain gored skirt (to a reduced scale), and method of making, mounting, facing, and braiding the same.

7. Drafting of diagram of a dress-bodice and sleeves, showing how the various parts of same should be cut from material of given width.

8. The fixing of the parts of a bodice ready for sewing, and mode of fitting a bodice to a given figure.

9. Simple methods of trimming and preparation of the same.

(3.) Specimen Work.—Each Candidate will be required, in the year preceding the Examination, to cut out and make up a full-size bodice or blouse, and to complete the same in all particulars. Button-holes are optional. Thin, loose materials in which it is difficult to show good workmanship should not be selected, and the bodice or blouse must be made up on a *fitted* lining ; wadding must not be used. The specimen bodice or blouse must be quite new and not previously worn.

Each Candidate must write a tabulated list of the measures which have been used in making the specimen bodice. *This list must be securely tacked to the lining of the back.*

The Class student who has executed her specimen work in class, under the eye of the teacher, but without her help, must produce a Certificate, to be forwarded with the work, signed by the teacher of the class, to the effect that the work has been done entirely by the student herself. External Candidates, or Candidates who have not done the work in class, must send in a Statutory Declaration, on a form to be obtained from the Institute, certifying that the work is wholly their own.

The work done at the Practical Examination, Section 1, together with the Specimen Work, Section 3, must be packed in a strong wooden box and forwarded, *carriage paid*, to London immediately after the Practical Examination. The Candidates' answers must be forwarded immediately after the Written Examination.

After the examination of the work in London, the bodice will be returned to the centre at which the Candidate was examined.

The Written Examination will be held on Thursday, May 2nd, from 7 till 10 p.m. Candidates should bring with them an inch ruler and pencil. No diagrams or charts are allowed.

The Practical Examination will be held on Saturday, May 11th, from 2.30 to 7.0 p.m.

Candidates who pass will receive Certificates and will be arranged in two divisions.

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### 65.—MILLINERY.

The Examination will be Practical and Written, and will be so arranged as to test the Candidate's skill in Millinery as well as her knowledge of the nature of the materials commonly worn.

The Examination will include—(1) Practical work, (2) Written answers to questions and drawing, (3) Specimen work done by the Candidate in class or at home.

The fee for the Examination is *Two Shillings and Sixpence* for Candidates who have made at least 20 attendances at a class registered by the Institute (see Rule 2) during the Session preceding the Examination, and *Seven Shillings* for other Candidates. Only Students who have regularly attended a registered class are eligible for prizes.

To obtain a Certificate, Candidates will be required to pass in each of the parts 1, 2, and 3.

(1.) **Practical Examination.**—The Candidate must be prepared to do any piece of practical work covered by the Syllabus. The materials required will be supplied by the Institute.

(2.) The Written Examination will include questions upon the following subjects :—

(1) (*a*) Materials suitable for various kinds of shapes ; (*b*) materials suitable for covering different shapes.

(2) Methods of taking (*a*) measurements, and (*b*) patterns of hat and bonnet shapes.

(3) Methods of (*a*) cutting out, and (*b*) making up net, buckram or sparterie shapes.

(4) Methods of making (*a*) wire shapes, (*b*) drawn shapes, (*c*) straw shapes, and (*d*) methods of covering buckram shapes.

(5) Terms peculiar to millinery, and the various stitches involved in the manipulation of lace, velvet, wire, crêpe, &c. ; also the renovation of various millinery materials.

(6) (*a*) Approximate statement of quantities and cost for hats and bonnets of given style and construction. (*b*) Suggestions for making and trimming a given hat or bonnet.

(7) Methods of (*a*) lining and binding hats according to current fashions. (*b*) Cutting materials on cross, corner, straight, or to shape. (*c*) Making up bows, rosettes, and other general forms of trimming. The making up of children's hats and bonnets in velvet, silk or cloth.

N.B.—Answers should be plentifully illustrated with diagrams.

(3.) Specimen Work.—Each Candidate will be required, in the year preceding the Examination, to make

(*a*) A velvet hat, plain covered, lined and trimmed with glace silk suitable for winter, cost of materials not to exceed 9s. 6d. (bill to be attached).

(*b*) A drawn silk hat suitable for a baby boy eighteen months old.

(*c*) A toque shape prepared for finishing as a floral toque.

After the Examination in London, the work will be returned to the centre at which the Candidate was examined.

The class student who has executed her specimen work in class, under the eye of the teacher, but without her help, must produce a Certificate, to be forwarded with the work, signed by the teacher of the class, to the effect that the work has been done entirely by the student herself. External Candidates or Candidates who have not done the work in class must send in a Statutory Declaration, on a form to be obtained from the Institute, certifying that the work is wholly their own.

The Work done at the Practical Examination, Section 1, together with the specimen work done by the Candidates, Section 3, and



such paper patterns and measurements as may be required with the specimen work, must be packed in a strong wooden box and forwarded, *carriage paid*, to London immediately after the Practical Examination. The Candidates' answers must be forwarded immediately after the Written Examination.

The Written Examination will be held on Tuesday, April 30th, from 7 till 10.

The Practical Examination will be held on Saturday, May 18th, from 2.30 till 6.30.

Candidates who pass will receive Certificates, and will be arranged in two divisions.

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### 66.—PLAIN NEEDLEWORK.

The Examination will be Practical and Written, and will be so arranged as to test the Candidate's skill in Plain Needlework and cutting out of underlinen, as well as her knowledge of the nature of the materials commonly worn.

Candidates for examination will be required to give evidence of having received during the Session preceding the Examination at least 20 lessons in a class registered by the Institute. (See Rule 2.) No Candidate not so qualified will be admitted to the Examination.

The fee for the entire Examination is *Two Shillings and Sixpence*.

Candidates will be required to pass in each of the parts 1, 2 and 3.

(1.) **Practical Examination.**—Each Candidate will be required—  
(1) to cut out any garment or section of a garment for underlinen *from memory*, or from given measurements, and to tack together such portions as may be indicated at the time of the Examination ;  
(2) to work any part of the specimens in Section 3 (a), (b) or (c).

The materials for the garment and specimen will be supplied by the Institute.

Candidates will be required to bring with them to the Practical Examination a tape measure, a thimble, scissors, needles, pins, pencil, sewing and crochet cotton.

(2.) **The Written Examination** will include questions on the following subjects :—

(1) The points to be observed in cutting out calico and flannel.

(2) The most suitable materials to be used for different undergarments.

(3) The different systems of cutting out and reasons of preference

- (4) Drawing a diagram of any garment of underlinen.
- (5) The cutting out of garments and their construction.
- (6) The various stitches and processes of work used in plain needlework and their application to garments.
- (7) Methods of patching and darning.

(3.) Specimen Work.—Each Candidate will be required, in the year preceding the Examination to complete, in all particulars, the work mentioned below in (a), (b), (c), and (d).

The work shown on the sampler should be such as the Candidate would use in the making of ordinary garments. The regularity of the stitches (particularly hemming and herring-boning) should be gauged by eye alone. *Exceptionally fine work is not desired and the habit of counting threads in working should not be practised.*

(a) A calico sampler to be worked as shown in Diagram A, showing the following stitches and processes :—

- |   |   |
|---|---|
| 1. Hemming.                                   | 12. Insertion of gusset.                          |
| 2. Sewing (or seaming) and felling.           | 13. Calico patch.                                 |
| 3. Gathers, and setting into band.            | 14. Opening as if for a chemise.                  |
| 4. Stitching, <i>i.e.</i> , "Back stitching." | 15. Feather ( <i>i.e.</i> Coral) stitch.          |
| 5. Pleating.                                  | 16. Sewing on tapes.                              |
| 6. Tuck run.                                  | 17. Sewing on a button.                           |
| 7. Marking.                                   | 18. Making a loop for button, and an eyelet hole. |
| 8. Button-hole.                               | 19. Piping.                                       |
| 9. Run and fell.                              | 20. A strengthening tape.                         |
| 10. Knotting.                                 |   |
| 11. Whipstitch and setting on frill.          |   |

The materials required for the calico sampler are :—

- |  |   |
|--|---|
| 1. A piece of moderately coarse calico (12 in. by 30 in.) with even threads. | 4. Crochet cotton, No. 16 or 18, for feather-stitching; flax thread may be used if preferred. |
| 2. $\frac{1}{2}$ yd. of mull muslin for frilling.                            | 5. $\frac{1}{2}$ yd. of tape.   |
| 3. Coloured cottons, No. 50 or finer, and No. 100 for frill (white).         | 6. $\frac{1}{2}$ yd. of piping cord.  |
|  | 7. An unpierced linen button about as large as a threepenny piece                             |

N.B.—Coloured cotton to be used throughout to show neatness in joining.

(b) A flannel sampler to be worked as shown in Diagram B, showing the following stitches and processes :—

- |  |   |
|--|---|
| 1. Herring bone stitch, and two methods of making seams. | 10. A strengthening tape.   |
| 2. Hemming.  | 11. Formation of a placket hole.  |
| 3. Stitching.  | 12. Scalloping.   |
| 4. Tuck running.   | 13. Putting on strings; (a) at the edge, (b) at a distance from the edge. |
| 5. Button-hole.  | 14. Putting on a button.  |
| 6. Marking.  | 15. A case for a draw string.   |
| 7. Feather-stitch.                                       | 16. A square patch.   |
| 8. Pleating, and putting on band.                        | 17. A triangular patch.   |
| 9. Putting on flannel binding.                           |   |

The materials required for the flannel sampler are :—

- |   |   |
|---|---|
| <ol style="list-style-type: none"> <li>1. <math>\frac{1}{2}</math> yard of flannel, about 28 inches wide, in which the threads can be easily seen.</li> <li>2. <math>1\frac{1}{2}</math> yards of flannel binding, about <math>\frac{1}{2}</math> inch in width.</li> <li>3. A piece of calico (12 in. by 4 in.).</li> <li>4. A linen button; <math>\frac{1}{2}</math> yard of tape.</li> </ol> | <ol style="list-style-type: none"> <li>5. A reel of coloured cotton, No. 40 or 50.</li> <li>6. A skein of fine flax thread, silk, or angola wool for darns.</li> <li>7. <math>\frac{1}{2}</math> yard of Briggs' transfer paper, and a skein of flannel silk for scalloping and feather stitching.</li> </ol> |
|---|---|

(c) Darning :—

- |   |   |
|---|---|
| <ol style="list-style-type: none"> <li>1. On flannel, as if for a thin place.</li> <li>2. On material—a hedge tear,<br/>or<br/>On linen—a cross cut.</li> </ol> | <ol style="list-style-type: none"> <li>3. On stocking web, as for a thin place.</li> <li>4. On stocking web, a hole as in ordinary stocking darning.</li> </ol> |
|---|---|

The specimens in (c) should be mounted on a card.

(d) Cutting Out :—

- |   |  |
|---|--|
| <ol style="list-style-type: none"> <li>1. A garment in lined extension paper, cut out and tacked together.</li> </ol> | <ol style="list-style-type: none"> <li>2. Three garments in calico, cambric or other material, cut out and tacked together.</li> </ol> |
|---|--|

As great a variety as possible should be shown in (d).

Diagrams of the garments (d), drawn on "Sectional Paper," scale of  $\frac{1}{4}$  size, to be sent with above, and the age or height of intended wearer should be given. The drawings should be arranged in a sectional book.

After the Examination of the work in London, the specimens submitted in accordance with Section 3 will be returned to the centre at which the Candidate was examined.

The Candidate who has executed her specimen work in class, under the eye of the teacher, but without her help, must produce a Certificate, to be forwarded with the work, signed by the teacher of the class, to the effect that the work has been done entirely by the student herself. Candidates who have not done the work in class, must send in a Statutory Declaration, on a form to be obtained from the Institute, certifying that the work is wholly their own.

The work done at the practical Examination, Section 1, together with the work done by the Candidates, Section 3, must be packed in a strong wooden box, and forwarded, *carriage paid*, to London immediately after the practical Examination.

The Candidates' Answer Papers must be forwarded immediately after the Written Examination.

The Written Examination will be held on Wednesday, May 1st from 7 till 10.

The Practical Examination will be held on Saturday, May 4th from 2.30 to 6.30.

Candidates who pass will receive Certificates and will be arranged in two divisions.

## 67.—PLAIN COOKERY.

The Examination will be Written and Practical, and will be so arranged as to test the Candidate's knowledge of the nature of the materials commonly used for food as well as her skill in Plain Cookery.

Candidates for examination will be required to give evidence of having received during the Session preceding the Examination at least 20 practical lessons in a class registered by the Institute: no Candidate not so qualified will be admitted to the Examination. Each lesson should, as a rule, be of two hours' duration, but the Institute, in special cases, will be prepared to consider applications for the approval of shorter lessons of  $1\frac{1}{2}$  hours' duration, provided that the student before being presented for Examination shall have received at least 40 hours' instruction.

The Examination will include (1) Written answers to questions; (2) Practical Cookery and Scullery work done by the Candidates in presence of a Local Examiner.

In order that a Practical Examination may be held at any Centre, *at least six Candidates* must present themselves at that Centre. When the number of Candidates is less than six, special arrangements may be made, either by transfer of the Candidates to some other centre, or by the payment by the Local Authority of the Local Examiner's fee.

To obtain a Certificate, Candidates will be required to pass in each of the parts 1 and 2. Both parts must be taken in the same year.

The fee for the entire Examination (Written and Practical) will be *Three Shillings and Sixpence*.

The material must be supplied by the School or Local Authority from particulars which will be furnished by the Institute.

(1.) **Written Examination**—The Written Examination will include questions on the following subjects:—

1. The lighting and management of a kitchen fire and gas stove. The construction of open and closed ranges with regard to the flues, ovens, hot water supply, etc.
2. Scullery work. The proper construction and the cleaning of a scullery sink, etc. The cleaning of utensils used in cooking.
3. The relative temperatures (moist and dry) in the primary methods of cooking. Simple tests for finding the required temperature of water, fat, oven, etc.
4. The primary methods of cooking. Simple rules based on the underlying principles.
5. The relative proportions of ingredients used to make simple dishes: puddings, pastries, sauces, etc.
6. Cleanliness in the preparation and cooking of food. The proper storage of food. The results of carelessness in these matters.
7. Economy in cooking—(time, fuel and food material). The use of forethought and routine in kitchen work. Marketing.
8. Suitable food for infants and children and invalids. Variation in diet advisable for hot and cold weather and for different occupations.
9. The arrangement of simple meals for a week.
10. Vegetarian diet. Meat substitutes.

(2.) **Practical Examination**—Each Candidate will be required—

1. To prepare and cook three or four named dishes (to be selected by the Examiner from the following), or to prepare a simple meal from given materials selecting the dishes herself :—

(1.) *Soupmaking.*

Lentil Soup.	Tomato Soup.
Pea Soup.	Mutton broth.
Potato Soup.	Bone stock.
Gravy Soup.	

(2.) *Methods of Cooking Meat and Fish.*

(a) Stewing.—Beef, Mutton, Tripe, Rabbit, Fish, Irish Stew.	(d) Grilling.—Chops, Steak, Kippers.
(b) Roasting.—Mutton, Beef, Pork (Gravies).	(e) Frying.—Bacon, Sausages, Chops, Steak and Onions, Liver, Fish.
(c) Boiling.—Mutton, Corned Beef, Fish.	(f) Reheating.—Cottage Pie, Hash, Mince, Fish Pie, Fish Cakes, Kedgeree.

(3.) *Pastry.*

Short, flaky, and suet Pastry.	Cornish Pasties.
Fruit Pie.	Meat Pudding.
Jam Tarts.	Dumplings.
Meat Pie.	Roly-poly.
Sausage Rolls.	

(4.) *Batters.*

Pancakes.	Yorkshire Pudding.
Fritters.	

(5.) *Custards.*

Baked.	Steamed and Cup Custards.
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(6.) *Milk Puddings.*

Rice and Sago Puddings.	Ground Rice and Cornflour Moulds.
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(7.) *Suet Puddings.*

Treacle, and Lemon Puddings.	Christmas Pudding and Fruit Puddings.
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(8.) *Cheese Dishes.*

Welsh Rarebit.	Rice and Cheese.
Macaroni Cheese.	

(9.) *Sauce Making.*

Plain White Sauce.	Anchovy Sauce.
Parsley Sauce.	Cornflour Sauce.
Caper Sauce.	Sweet Sauce.
Egg Sauce.	Jam Sauce.

(10.) *Bread and Cakes.*

White and Brown Bread.	Rock Cakes.
Scones.	Shortbread.
Sponge Cake.	Oatmeal Biscuits.
Fruit Cake.	

(11.) *Invalid's Dishes.*

Beef Tea.	Steamed Fish.
Barley Water.	Gruel.
Boiled and Poached Eggs.	

(12.) *Vegetables.*

Potatoes, baked, boiled, steamed, fried.	Root Vegetables.
Green Vegetables.	Dried Vegetables.

(13.) *Miscellaneous.*

Tea.	Porridge.
Coffee.	Potted Meat.
Cocon.	Sandwiches.
Baking Powder.	Omelets.
Clarified Fat.	Salad.

2. To dish the food up when cooked in a suitable manner for serving at table.

3. To scrub and polish and leave tidy all the utensils used in the process, according to the best methods, as showing specimens of Scullery work.

Candidates will be required to bring with them to the Practical Examination a large bib apron, sleeves, and kitchen cloth.

Three hours will be allowed for the Practical Examination.

The work done by the Candidates at the Practical Examination will be marked as it proceeds by an Examiner approved by the Institute.

The work done at the Written Examination, and the Form containing the marks awarded by the Local Examiner for the Practical Test, must be forwarded to the Offices of the Department of Technology at the conclusion of each Examination.

The Written Examination will be held on Monday, April 29th, from 7 till 10.

The Practical Examination will be held on Saturday, April 27th, from 4 to 7 p.m.

## 68.—BASKET-WORK.

The Examination will be Written and Practical, and will be so arranged as to test the Candidate's skill in Basket-work in its various forms and applications, as well as his knowledge of the various materials commonly employed.

Candidates for examination who have received during the Session preceding the Examination not less than 20 lessons in a class registered by the Institute will be required to pay an Examination Fee of *One Shilling*.

Candidates who have not regularly attended a registered class will be admitted to the Examination, but such Candidates will be required to pay a fee of *Three Shillings and Sixpence*, and will not be eligible for prizes.

The material for the Practical Examination must be supplied by the Local Authority. In order that the materials required may be properly prepared, particulars as to the kind and quantity will be supplied to the Local Examination Secretary at least one week before the date of the examination.

The examination will include—(1) Practical work ; (2) Written answers to questions ; (3) Specimen work done by the Candidate during the session preceding the examination.

In order to obtain a Certificate in either grade, Candidates will be required to pass in each of the parts 1, 2, and 3.

### GRADE I.

(1.) The Written Examination will include questions on the following subjects :—

(1) Osiers : different kinds and sizes, their qualities and uses.

The cultivation of osiers. Cutting, sorting, peeling, and buffing. Preparation for use. Staining, varnishing.

(2) Cane, whole and pith : different kinds and sizes ; qualities and uses. Preparation for use. Staining, varnishing.

(3) Tools and appliances : their uses.

(4) Round or oval slath. Upsetting, slewing, randing, fitting, pairing. Wales—three, four, five, or six rod. Borders—plain three, four, five, or six stroke. Footing. End, or cross handles. Hasps and nooses. Ties and bands. Stakes, scalloms, bye-stakes, leagues, liners.

(5) The construction of ordinary round and oval baskets in osier and cane pith.

(2.) Practical Examination.—Each Candidate will be required, in the presence of the Superintendent, to make some specimen of round or oval work in osier or cane pith, as may be specified at the time of the examination.

Candidates will be required to bring with them the usual tools and appliances.

(3.) Specimen Work.—Each Candidate will be required, in the year preceding the examination, to make and complete in all particulars, one specimen of round, and one specimen of oval work.

The design, construction, and execution of the specimen work will be considered, also any originality of workmanship that is useful or practical.

The Specimen work must be forwarded, as directed (carriage paid) to London, not later than April 29th.

A Certificate signed by the Candidate's employer, or by the Class Teacher and a member of the School Committee, stating that the work has been executed by the Candidate himself, without assistance, *must be forwarded with the Specimen*. In cases where the work has been executed at the Candidate's own residence, a Statutory Declaration will be required. Forms for either the Certificate or the Declaration may be obtained on application.

### FINAL EXAMINATION.

Candidates will be required to bring with them the usual tools and appliances.

(1.) The Written Examination will include questions on the following subjects:—

(1) Process of making Skeins—cleaving, shaving, uprighing. Material other than osier used in fancy work. Staining, varnishing.

(2) Construction of upright round linen, or similar basket; bird-cage, round or square; chicken crate; bottle and carboy casing.

(3) Square basket: preparing bottom, staking and upsetting, for any given size, both with and without corner sticks. The corner border.

(4) Borders: plain, plaited or braided, rope or cable, scallop, tracking.

(5) The construction of a fitted garden chair, fancy chair, lounge chair, afternoon tea stand with two tiers, afternoon tea table with two or three trays.

(6) The construction of picnic, luncheon and tea baskets. Partition baskets, covered and open:—quart and pint wine baskets; champagne baskets, sample baskets, acid baskets, baskets for glasses, etc.

(7) Pony chaise bodies; motor car bodies.

(8) Dress baskets; travelling hampers; pigeon baskets; conjurors' baskets.

(9) Letter and waste paper baskets.

If Candidates are able to make sketches to illustrate their answers it will save time, and add to the value of the exercise.

The Candidates' answers must be packed up, and forwarded to the Offices of the Department, Exhibition Road, immediately after the examination. The Practical work must be sent as directed.



(2.) **Practical Examination.**—Each Candidate will be required, in the presence of the Superintendent, to make any ordinary specimen of Basket-work that may be specified at the time of the examination.

(3.) **Specimen Work**—Each Candidate will be required, in the year preceding the examination, to make and complete in all particulars a specimen of advanced basket-work, in the construction of which other materials in addition to osiers may be used, *e.g.*, hazel, straw plait, plaited rush, cane, whole and pith, plain or enamelled, etc. The exercise should be so selected as to show the Candidate's ability in design and construction, and the application of osier weaving to purposes beyond the ordinary forms of basket-work—travelling trunks, chairs, tables, stands and the like.

Originality of design or workmanship will be especially considered.

The specimen work must be forwarded as directed (carriage paid) to London, not later than April 29th.

A Certificate signed by the Candidate's employer or by the Class Teacher and a member of the School Committee, stating that the work has been executed by the Candidate himself, without assistance, *must be forwarded with the Specimen*. In cases where the work has been executed at the Candidate's own residence, a Statutory Declaration will be required. Forms for either the Certificate or the Declaration may be obtained on application.

The Examination, in both grades, will be held on **Saturday, May 4th**, from 2.30 to 6.30 p.m. the Written from 2.30 to 3.30 p.m., and the Practical from 3.30 to 6.30 p.m.

Candidates who pass will be arranged in two divisions and First and Second Class Certificates will be awarded to them according to their proficiency.

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## 69.—BUILDERS' QUANTITIES.

Students before entering for this examination should have a practical knowledge of Building Construction.

**I. Syllabus.**—The Examination will include questions founded on the following subjects, and due allowance will be made for differences of local practice :—

### GRADE I.

Taking off ; squaring dimensions, and reducing same ; abstracting ; billing.

The mode of measurement of the following :—

*Earthwork and Concrete*, including excavation over surface or for trenches and basements ; strutting and planking for same ;

concrete flooring, walling, and foundations ; concrete reinforcement.

*Drainage*, including inspection chambers, pipes, junctions, traps, connections to sewers, etc.

*Brickwork*, in mortar or cement, including party walls, chimney breasts, boundary walls, trimmer and relieving arches ; facings ; moulded courses ; damp courses ; battered or circular work.

*Masonry*, including solid steps (square and spandril), hearths, thresholds, copings, templates, paving.

*Slating and Tiling*, straight, circular, or vertical, including ridges, hips, and valleys.

*Carpentry and Joinery*, including windows, doors, staircases, etc. ; batten and block flooring ; centering ; roofs, floors and partitions.

*Plumbing and Zinc Work*, including flats, gutters, cisterns, bath and lavatory fittings, etc.

*Smiths' and Founders' Work*, including joists and girders ; gutters, pipes, and fittings ; sashes and frames ; casements ; iron roofing ; and constructional steelwork.

*Plasterers' Work*, including moulded cornices, enrichments, and soffits ; Keene's cement dadoes ; Portland cement floors and skirtings ; roughcast and stucco work.

*Painting* on iron, woodwork, or walls, external or internal, including distemper, graining, staining, and lettering.

*Glazing*, including lead lights, etc.

#### FINAL EXAMINATION.

In this examination more difficult questions will be set in the foregoing subjects, and in addition sufficient knowledge will be required for the following :—

To take off quantities, abstract, and bill, from scale-drawings, a section of work comprising any of the following branches of the Building Trade :—

Excavation, Concrete, and Drainage work ;

Bricklaying and Masonry ;

Slating and Tiling ;

Carpentry, Joinery, and Ironmongery ;

Smiths' and Foundry Work ;

Plasterers' Work ;

Plumbing and Zinc Work ;

Gas and Hot Water Fitting ;  
 Painters' and Glaziers' Work ;  
 and price same in accordance with local rates.

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The Examination in both grades will be held on Tuesday, April 30th, 7 to 10 p.m. The Fee for Examination in either grade is *One Shilling and Sixpence*.

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II. Full Technological Certificate.—For the Full Technological Certificate, Candidates will be required to qualify as stated in Rules 29 and 30, but a Certificate in Architecture will be accepted in lieu of a certificate in one of the Science Subjects. Alternatively, Candidates may qualify by passing the examination of the Board of Education in Elementary Practical Mathematics, and the Final examination of the Institute in *one* of the following subjects :—

Plumbers' Work.  
 Carpentry and Joinery.

Brickwork.  
 Masonry.

III. Works of Reference.—Rivington's "Building Construction"; Leaning's "Quantity Surveying" (Spon); Mitchell's "Building Construction"; Laxton's "Price Book"; W. E. Davis's "Quantities and Quantity Taking" (Whittaker); J. T. Rea's "How to Estimate" (Batsford).

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## 70.—WHEELWRIGHTS' WORK, AND VAN AND CART BUILDING.

I. Syllabus.—The Examination will include Drawing and questions founded on such subjects as the following :—

### GRADE I.

(1.) Written Examination.—Questions will be set on the following :—

1. The nature and properties of the various kinds of timber used in the construction of vans, carts, and wheels, with special reference to their power of resisting wet. Also the properties of metals used in van and cart building, with special attention to the several purposes for which wrought iron and malleable castings can be advantageously used.

2. The forms and characteristics of the several kinds of axles or arms in general use, and their suitability to light or heavy carts or vans.

3. The making of wheels by hand and machinery, including the setting out of the spokes to the hub or "stock," tonguing of spokes, marking the felloes, boring and dowelling, and "dishing of wheels."

4. Painting, lining, and varnishing.

(2.) **Drawing.**—Candidates in Grade I will be required to make a simple scale drawing of builders', milk carriers', or millers' vans or carts, or of the component parts of such vehicles, for which purpose the use of ordinary mathematical instruments, including a scale rule and squares, but no patterns, will be allowed.

*Candidates for either Grade should be provided with drawing instruments. Drawing paper will be supplied, if necessary, by the Institute.*

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#### FINAL EXAMINATION.

(1.) **Written Examination.**—In the Final Examination more difficult questions will be set in the above subjects, and, in addition, a knowledge will be required of:—

1. The various machines used in van and cart building and wheel making, special attention to be given to those by which the cost of production is lessened.

2. Detailed particulars of home and foreign grown timbers used in the trade—their selection and adaptability to the various parts of vehicles, and the best modes of storing and drying.

3. The relative merits of iron and steel. The suitability of each metal for the respective parts of a body, with special reference to the advisability of using steel tubing.

4. The several parts, with dimensioned sketches to scale, of brewers', distillers', railway carriers', grocers', and various kinds of vans with curved or "compass" fronts.

(2.) **Drawing.**—Candidates in the Final Examination will be required to prepare a design, the data for which will be given at the time of the Written Examination. The design to be worked out and drawn, and the drawings, with description, calculations, &c., to be returned to the Offices of the Department not later than Wednesday, May 22nd.

A Certificate signed by the Candidate's employer, or by the Class teacher, and a member of the School Committee, stating that the work has been executed by the Candidate himself, without assistance, *must be forwarded with the Drawing*. In cases where the work has been executed at the Candidate's own residence, a Statutory Declaration will be required. Forms for either the Certificate or the Declaration may be obtained on application to the Institute.

Candidates may use ordinary mathematical instruments.

The written Examination in both grades will be held on Thursday, May 2nd, 7 to 10 p.m.

The fee for Examination in Grade I is *One Shilling*; for the Final Examination *Two Shillings and Sixpence*.

**II. Full Technological Certificate.**—For the Full Technological Certificate, the Candidate must qualify as stated in Rules 29 and 30, but certificates showing that he has passed the examinations of the Board of Education in Geometrical Drawing, as well as in Free-hand or Model Drawing, will be accepted in lieu of one of the Science Certificates.

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## 71.—LEATHER DYEING AND FINISHING.

Students are recommended to attend a Course of Instruction in the subjects included under the Syllabus for Grade I of Leather Tanning or of Dressing of Skins before entering for a Course of Instruction in this subject.

**I. Syllabus.**—The knowledge required in Grade I will be mainly practical, and such as may be expected from an intelligent workman; while in the Final Examination accurate scientific information, and the power of applying it to technical purposes, will be expected. The examination will include questions founded on such subjects as the following :—

### GRADE I.

1. Varieties of leather suitable for dyeing. Chemical and physical properties.

2. Operations preliminary to dyeing and staining. Sorting scouring, clearing, sumaching, sweetening, etc. Bleaching and mordanting. Degreasing and fat-liquoring.

3. Various methods of applying colouring matters to leather. Machines used for same. Relative advantages and disadvantages of different methods.

4. Water. Influence of impurities upon dyeing.

5. Natural colouring matters—logwood, fustic, indigo, cudbear, orchil, turmeric, and cochineal. Methods of extraction and application.

6. Mordants. Salts of alumina, tin, chrome, iron, copper, titanium, antimony, etc. Soaps and oils. Albumen, etc.

7. Mineral colouring matters. Application of mineral pigments to leather.

8. Processes after dyeing. General finishing operations. Seasoning, topping, flaming. Graining, printing or embossing. Glazing, corking, staking, etc.

The Examination in both grades will be held on Tuesday, April 30th, from 7 to 10 p.m. The fee for examination in either grade is *One Shilling and Sixpence*.

#### FINAL EXAMINATION.

Candidates taking the Final Examination will be expected to answer more difficult questions on the above subjects, and will also be expected to have a knowledge of :—

1. Purification of water. Methods of detecting impurities in water, and correction for dyeing.

2. The chemical and physical properties of the principal coal-tar colouring matters. Estimation of dyeing power. Detection of adulterants. Fastness to light, heat, etc. Dyeing to pattern.

3. The theory of dyeing. Methods of making dyeing experiments.

4. The composition of seasons, glazes, and other materials used in the finishing of leather.

5. The formation of colour lakes. General principles of colour mixing, colour measurement. The spectroscope and its use.

6. General methods in use for dyeing chrome, alum, chamois, and vegetable tanned leathers and skins for rugs.

7. General arrangement of dye-house, finishing shop, and drying rooms.

8. Calculation of costs and valuation of stock in dyeing. Treatment of waste dye liquors and recovery of by-products.

II. Full Technological Certificate.—For the Full Technological Certificate, the Candidate must qualify as stated in Rules 29 and 30.

III. Works of Reference.—“Principles of the Science of Colour,” William Benson (Chapman & Hall). “Colour Measurement and Mixture,” Sir W. de W. Abney. “Colour Vision,” Sir W. de W. Abney (Tyndall Lectures). “Colour,” G. H. Hurst (Scott, Greenwood & Co.). “Colour,” A. H. Church (Cassell). “Manual of Dyeing,” Rawson, Knecht & Löwenthal (Griffin). “Dyeing of Textile Fabrics,” Professor Hummel (Cassell). “Leather Dressing and Dyeing,” by M. C. Lamb (Leather Trades Publishing Co., 1907). “Die Feinleder Fabrikation,” by Joseph Borgman (Krayn, Berlin). “Das Färben des lohgaren Leders” Jettmar. “Principles of Leather Manufacture,” H. R. Procter (Spon). “Journal of the Society of Dyers and Colourists.” “Dyer and Calico Printer.” “Leather Trades Review.” “Journal of the Society of Chemical Industry.” Der Ledermarkt (Collegium).

## 72.—THE PRINCIPLES OF ART AS APPLIED TO THE DESIGN OF PATTERNS FOR WEAVING.

This subject deals with the production of Artistic Design which is suitable for application to woven textiles.

The courses of instruction are intended to cover two years and to run concurrently with the weaving courses in the following subjects :—Woollen and Worsted Weaving (Division I. or Division II.), Cotton Weaving (second year and third year's course, Section A, Applied Design), Linen Weaving (Section A or B), Silk Weaving, Jute Weaving (Section A or B).

It is desirable that all students before attending the first year's course should give evidence of some degree of proficiency in Freehand Drawing.

First and Second Class Certificates will be issued on the results of the Examinations in both grades.

Each year's work is indicated in the following syllabuses, which include the subjects on which the Examination questions will be based.

### I. Syllabus:—

#### GRADE I.

1. *Drawing*.—Drawing—the first step towards design ; Tracing ; Transferring ; and making drawings in water colour and body colour.

The making of clean, businesslike and presentable working-drawings of given patterns.

(Students should not be allowed to attempt anything in the way of design until they can do that.)

Very simple drawing from Nature, and from examples of woven and other Patterns.

2. *The Basis of Pattern*.—The Geometric basis of Pattern Design. The Planning of pattern—i.e., the ways in which it may be set out ; and, in connection with that, the Analysis of pattern.

The way to set about Pattern Design on whatever basis. Its leading lines. The distribution of its parts and masses. The relation of detail to its distribution.

(Very formal arrangement implies, for example, correspondingly formal detail, and more natural detail freer lines of distribution.)

3. *Nature Study and the Treatment of Natural Form*.—The treatment of Natural forms with a view—(1) to Ornament, (2) to Repeated Pattern, (3) to Woven Pattern, (4) to Particular Fabrics (such as damask).

4. *Adaptation.*—The Adaptation of a very simple given design to some quite different proportions, or to a quite different purpose.

(A great part of what pattern designers are called upon to do is not much more than adaptation. And it is excellent preparation for original design.)

5. *Colour.*—Colour matching. Harmony of colour—i.e., the difference between crude and bright colour. The value of contrast. The effects of juxtaposition. The necessity for reticence in colour. The value of broken colour; and the weaver's means of getting it. Colouring a given pattern in various ways.

Inventing or remembering patterns (such as stripes, checks and simple geometric diapers) in which practically everything depends upon the colour, and especially upon the proportion and the relative strength of the colours.

6. *Pattern Design.*—The various Types of pattern—as geometric, interlacing, counterchange, sprig, floral—with some reference to the Historic Styles, in which such types of pattern are best represented.

(Good examples of traditional and Historic textile pattern should be put before the students; and it should be explained to them why, and in what respect, they are good, and how they were affected by, and often grew out of the conditions of, weaving. They should be told in passing something about the origin and history of such patterns. This would add to their interest in Historic ornament, and would be the beginning of an acquaintance with the "Styles" of ornament, with which a practical designer must be familiar, and in which questions may be set in the Final Examination.)

Simple Design—in which beauty of line and colour should be insisted on, and originality should not be expected.

(Originality, though always to be encouraged, ought not to be asked for in the first stages of teaching. It is too much to expect of beginners; and the striving for it leads to affectation and eccentricity. Originality will develop itself if it is there.)

### FINAL EXAMINATION.

Candidates must have previously passed in Grade I of this subject, and in order to ensure that all candidates shall have acquired the requisite knowledge of the technique of weaving, those candidates only will be eligible for this examination who already hold a certificate in Grade I of Silk Weaving or in Grade II of either Cotton, Woollen and Worsted, Linen or Jute Weaving.



1. *The Basis of Design.*—The Geometric basis of Pattern Design.

The planning of pattern—*i.e.*, the ways in which it may be set out. The Analysis of pattern. The way to set about Pattern Design, on whatever basis. Its leading lines. The distribution of its parts and masses.

The relation of detail to its distribution.

2. *The Study and Treatment of Natural Form.*—The study of Plant form. Its adaptation to ornament—and especially to textile design. The relation of Natural form generally to ornament; and its treatment with a view to (1) Repeated Pattern, (2) Woven Pattern, (3) Particular Fabrics—such as damask, velvet, brocade, (4) Particular uses—as for dress stuffs, furniture—coverings, curtains, carpets and the like.

The similar treatment of Animal and other form.

(This last, however, is of secondary consideration. Designers that way inclined will introduce animal forms into their pattern; but it is chiefly upon floral and conventional forms that the pattern designer will depend.)

3. *Adaptation.*—The adaptation of a given design to quite different proportions or to a quite different purpose. Pattern drawing from memory.

4. *Colour.*—Harmony of colour. The value of contrast and the effects of juxtaposition. The necessity for reticence in colour. The value of broken colour, and the weaver's ways of getting it. The softening of harsh forms by contrasting colours. The emphasising of forms by contrasting colours.

Generally, how the colour affects a pattern—making or marring the design, according as it brings one feature of it or another into prominence.

Designing a pattern and suggesting various schemes for colouring it.

Designing patterns in which practically everything depends upon the colour, and especially upon the proportion and the relative strength of the colours.

Designing patterns to be woven in a given number of colours—according to the conditions of the loom.

5. *Style.*—The various Types of Pattern—as geometric, interlacing, counterchange, scroll, sprig, arabesque, floral, animal, &c.

The study of Traditional Design. What is to be learnt from it, and what is to be avoided. How it was affected by, and grew out of, the conditions of weaving, &c.

The characteristics of the Historic Styles.

(Good examples of pattern design should be put before the students. It should be explained why, and in what respect, they are good ; and the students' interest aroused in them.)

6. *Design*.—Making full size "all over" designs for textiles of various kinds.

Making colour designs to scale, for enlargement.

Making designs for borders and for corner treatments ; for borders to go with given fillings, and for fillings to go with given borders.

Making designs for a given fabric (damask, &c.).

Making designs for a given use (dress material, &c.).

*Note*.—(Originality of design is always to be encouraged, but no great originality should be expected of students. It will develop itself if it is there ; and striving after it leads only to affectation. The more important thing in the design of students is beauty, and the most important is fitness.)

The Examinations in both grades will be held on **Saturday, May 18th**, from 2.30–6.30. The fee for the Examination in either grade will be *Two Shillings and Sixpence*.

II. *Works of Reference*.—"Decorative Brush Work and Elementary Design," H. Cadness ; "Ornamental Design for Woven Fabrics," Stephenson and Suddards (Methuen) ; "Historic Ornament," R. Glazier ; "Ornamente der Gewebe," Fischbach ; "L'Ornement des Tissus," Dupont-Auberville ; "Textile Fabrics," Dr. Rock ; "Plant Form and Design," Midgley & Lilley (Chapman & Hall) ; "Pattern Design," "Ornament and its Application," and "Nature and Ornament," Lewis F. Day (Batsford) ; "Line and Form," and "The Basis of Design," by Walter Crane (G. Bell & Sons) ; "Practical Designing," edited by Gleeson White (G. Bell & Sons).

### 73.—TAILORS' CUTTING.

I. *Syllabus*.—The course of instruction is intended to cover a period of at least two years, and the lessons are expected to occupy from four to six hours a week for *not less* than twenty weeks in the Session.

The Examination in each grade will consist of two parts, a Written Examination and a Practical Test.

In order to enable them to make drawings with reasonable rapidity, candidates in either grade should prepare and bring with them to the Written Examination a set of  $\frac{1}{4}$ -in. scale block patterns of a lounge coat, morning coat, dress coat and D.B. frock coat (with

skirts for the last three coats named) ; a single-breasted waistcoat, walking trousers and riding breeches. As each candidate will be required to forward, with his answer paper, the block patterns which he uses, he should retain a duplicate set. Candidates should also bring to the examination black and coloured pencils.

### GRADE I.

(1.) **Written Examination.**—The Written Examination will consist of two parts, a General section and Special Subjects.

#### *General Section.*

1. The Principles of Measurement. Record of Measurements.
2. Study of the Male Figure. Normal proportions of the figure at different ages ; comparative scale of sizes.
3. Abnormal figures. The stooping figure. The erect figure. The corpulent figure. High, low, round and square shoulders. Enlarged scyes and large shoulders. Long neck. Short Neck. Prominent calves. Knock knees. Bow legs.
4. The Principles of scale drawing and drafting. Construction lines. The drawing of diagrams and the drafting of patterns from given measurements. Marking position of pockets.
5. Block patterns ; their use and adaptation.
6. Materials. Influence of the nature of the material on the allowances for making up. Allowances for paddings. The methods of laying patterns to suit the various classes and designs of material.

#### *Special Subjects.*

1. *Trousers.*—(1.) The principles of trousers cutting. How to lay patterns (*a*) with a view to economy, and (*b*) to suit the various classes and designs of material.

(2.) Trousers for normal and abnormal figures. Narrow legs. Wide legs. Straight legs. Riding trousers. Peg tops. Bell bottoms.

2. *Vests.*—(1.) The principles of vest cutting. How to lay patterns (*a*) with a view to economy, and (*b*) to suit the various classes and designs of material.

(2.) Vests for normal and abnormal figures (with and without collars). Single and double-breasted ordinary vests. Single and double-breasted dress vests. Sleeved vests.

3. *Coats.*—(1.) The principles of coat cutting. How to lay patterns (*a*) with a view to economy, and (*b*) to suit the various classes and designs of material.

(2.) Coats for normal and abnormal figures. Single and double-breasted frock coats. Single and double-breasted morning coats. Ordinary and roll collar dress coats. Dress jacket. Lounge, Norfolk and Reefer coats.

(3.) Overcoats. Frock overcoat. Single and double-breasted Chesterfields. Sac overcoat. Inverness. Ulsters. Hoods and capes. Covert coat. Prevailing style of overcoat.

(2.) **Practical Examination.**—In the Practical Examination, each candidate will be required to draft a coat, vest or trousers on paper.

Candidates will be required to bring with them to the examination chalk, tape, straight edge, square.

The Written Examination in Grade I will be held on **Monday, April 29th**, from 7 to 10 p.m.

The Practical Examination will be held on **Saturday, May 11th**, from 2.30 to 5.30.

The fee for the examination in Grade I is *Three Shillings and Sixpence*.

#### FINAL EXAMINATION.

*Candidates for the Final Examination must hold a Certificate in Grade I.*

(1.) **Written Examination.**—In addition to the subjects for the Grade I, candidates must show an acquaintance with the following :—

##### *General.*

1. Materials as affecting fit and cutting. Linings most suitable for various materials and styles. Trimming; materials and quantities required.

2. Trying on. How to prepare the garment. The process of fitting on.

3. Making up. Shaping. Staying. Pockets. Putting in sleeves. Making collar.

4. Examination and "passing" of finished garments.

5. Alterations.

##### *Special Subjects.*

1. *Trousers.*—For walking and general use.

2. *Breeches.*—Livery, riding, shooting, clerical breeches and Court dress. Knickerbockers and knicker breeches. Pantaloon.

3. *Gaiters and Leggings.*—Spats. Leggings. Livery, clerical and shooting gaiters.

4. *Waistcoats*.—Dress and Court dress. Single-breasted clerical and cassock waistcoats. Coachmen's and footmen's livery waistcoats.

5. *Coats*.—

(1) Clerical coats. Frock and dress coats. Court dress coats.

(2) Livery coats for coachmen, grooms and footmen.

(3) Hunting coats.

6. *Overcoats*.—Livery boxcoats.

(2.) **Practical Examination**.—Each Candidate will be required to draft, cut out, and baste one of the garments specified in the Syllabus for the Written Examination. The cloth required will be supplied by the Institute.

Candidates will be required to bring with them to the Examination shears and sewing materials.

(3.) **Specimen Work**.—Each Candidate for the Final Examination must show his proficiency in tailoring by submitting a coat made by himself, which must be quite new and not previously worn, and made during the twelve months preceding the examination together with a certificate that the work is entirely his own. Forms for the certificate may be had on application.

The Final Written Examination will be held on **Monday, April 29th**, from 7 to 10.

The Final Practical Examination will be held on **Saturday, May 18th**, from 2.30 to 7.

The cloth for the Practical Test will be supplied by the Institute, and the Candidates' work will be returned to the Centre after the examination. The work executed at the Practical Examination, together with the Specimen Work, must be carefully packed and forwarded to London, *carriage paid*, immediately after the Practical Examination.

The fee for the Final Examination (Written and Practical), including the cost of material, will be *Twelve Shillings and Sixpence*.

**II. Works of Reference**.—The following publications of the John Williamson Co., 42, Gerrard St., London, W. :—"Defects, remedies, trying-on," "Cutting by model patterns," "Economical cutting," "Cutting-room routine," Wampen's "Anatomy," Wampen's "Anthropometry," "System," by Tonkin, "The Art of Measuring," "The Trimmer's Guide and Cutting Instructor"; "Tailoring Problems and their Solution" (John Williamson Co., London); "Pocket Edition of the Cutter's Practical Guide," by W. D. F. Vincent.

## 74.—MOTOR CAR ENGINEERING.

The course of instruction in this subject should occupy at least three years. Examinations will be held at the end of each year's course.

Students are advised to take a course of instruction in some or all of the subjects included in the first stage of "Practical Mathematics," "Heat Engines," "Machine Construction and Drawing," and "Magnetism and Electricity," of the Board of Education, or their equivalents, before commencing this subject.

Slide rules and tables of logarithms may be used at the Examination. In problems involving calculations, more importance will be attached to method than to arithmetical accuracy.

## I. Syllabus :—

## GRADE I.

*Petrol.*—Source, distillation, density, and calorific value. Handling and storage.

*Carburation.*—The properties of petrol, explosive mixtures, cooling effect of evaporation.

*Carburettors.*—General principle of the action of a float-fed spray Carburettor and description of the forms in common use. Variable mixture supplied by simple "jet-in-tube" Carburettor, and the principles of the devices in common use attempting to correct this defect. Location of faults in fuel system.

*Indicated and Brake Horse-power,* compression ratios, heat of compression, difference between adiabatic and isothermal compression. Graphic representation of work, indicator diagrams. Difficulty of measuring indicated horse-power accurately. Brake horse-power and method of measuring same. Mechanical efficiency. Thermal efficiency. Heat losses. Fuel consumption. Calculations involved in connection with the above.

*Engines.*—General construction of two- and four-stroke-Cycle Engines, various forms of engines, valves and operating mechanisms in common use. Valve timing; lubrication, cooling, practical treatment generally and locating faults. Such elementary information regarding balancing and torque as will enable the student to understand the advantages of various forms of engines and the principles governing their design.

*Gearing.*—Angular ratio of trains of gear wheels other than epicyclic gears. Relative torque in shafts, properties of differential gears. Efficiencies of different forms of gearing. Tractive force. Road and wind resistance and gradients. Braking effect. Problems involving simple calculations with the above.

*Chassis Parts.*—General description of the construction of various types in common use of the following :—Clutches, change speed gears, universal joints, transmission to road driving wheels, brakes, steering gears, circulating pumps, fans, radiators, bearings, lubricators, springs, shackles, torque rods, radius rods, silencers, etc.

✎ Means for operating clutches, speed gears and brakes. Locating faults in and practical treatment of the above.

✎ *Materials of construction.*—Composition, properties, methods of working and treatment of the materials in common use.

**ELECTRIC IGNITION.**—*Electricity.*—Such elementary information regarding electricity and magnetism as will enable the student to form an intelligent idea of the operation of batteries, coils, and magnetos, as used for ignition.

*Batteries.*—Brief description of primary batteries. Secondary batteries, general construction, charging and treatment generally. Ohm's law.

*Coils and Magnetos.*—High and low tension sparks, effect of pressure on the length of spark. Electro-magnetic induction. Construction and theory of working of ignition coils, high and low tension magnetos, operating mechanism, timing ignition. High and low tension distributors.

*Sparkling Plugs.*—Construction, weaknesses and general treatment.

*Wiring.*—Various systems in common use. High and low tension distribution.

(*Note.*—Students should be encouraged to use coloured inks or pencils when drawing diagrams of coils, magnetos and ignition systems, say red for low tension conductors, blue or green for high, and black for other constructional parts.)

Locating faults in ignition systems.

The Examination in Grade I will be held on **Monday, April 29th**, from 7 to 10 p.m. The fee for Examination is *One Shilling*.

## GRADE II.

*Candidates for this Grade must have previously passed the Examination in Grade I.*

Candidates will be expected to possess a more advanced knowledge of the subjects mentioned in the syllabus for Grade I, and in addition a knowledge of the following subjects :—

*Petrol.*—Methods for testing. Other fuels in commercial use on internal combustion motor road vehicles.

*Carburation.*—Effect of air-petrol ratio on composition of exhaust gases, on rate of combustion, on mean effective pressure and on efficiency.

*Carburettors.*—Pressure-fed systems. Effects of valve stem leakage, condensation in induction pipe and throttled petrol supply. Causes of flooding. Brief description of carburettors, other than the float-fed spray kind.

*Indicated and Brake Horse-power.*—Thermo-dynamic principles of the internal combustion motor. High-speed engine indicators, analysis of diagrams, torque or crank effort curves from the indicator diagram. Horse-power formulæ based on engine dimensions.

*Engines.*—Calculation of stresses in engine parts, problems on balancing and the effect of inertia on the torque diagram. Effect of obliquity of the connecting-rod, forced vibration in shafts, design of poppet-valves and cams.

*Gearing.*—Epicyclic gears. Geometrical properties and construction of various forms of tooth gearing. Side slip.

*Efficiency.*—The problem of the efficiency of the machine as a whole and in detail, studied quantitatively.

*Chassis Parts.*—Calculation of stresses in members of transmission. Means for adjustment for wear. Governors, shock absorbers, detachable wheels and rims.

*Lubricants.*—Properties, flash point, composition, impurities.

*Ignition.*—Synchronised ignition, two-point ignition and effect of nature of spark on ignition.

The Examination in Grade II will be held on Wednesday, May 1st, from 7 to 10 p.m. The fee for examination is *one shilling and sixpence*.

#### FINAL EXAMINATION.

*Candidates for the Final Examination must hold a certificate in Grade II.*

The Examination in this Grade will consist of two parts—a Written Examination and a Drawing Examination to test the Candidate's knowledge of proportion and his quickness and accuracy in designing.

(1.) *Written Examination.*—In addition to a more advanced knowledge of the matter comprised in the syllabuses for Grades I and II, candidates will be expected to possess a knowledge of steam road vehicles, and of the general problems of motor car engineering. The questions will not necessarily be limited to the subjects specified in the foregoing syllabuses.



(2.) **Drawing Examination.**—Candidates may be asked to design any of the mechanical details in a petrol or steam car; a choice of subjects will be given.

Plain paper or paper ruled in  $\frac{1}{2}$ -in. squares will be provided by the Institute; all necessary instruments must be provided by the Candidates or the school.

Neat, carefully proportioned hand sketches are all that is required, and these should contain sufficient detail to enable a draughtsman to prepare working drawings from them. The dimensions of parts should be judged by eye and should not be inserted.

Marks will be awarded for correct proportions.

The Final Written Examination will be held on **Monday, April 29th**, from 7 to 10 p.m., the Drawing Examination on **Wednesday, May 1st**, from 7 to 10 p.m. The fee for the entire Examination, Written and Drawing, is *Two Shillings and Sixpence*.

**II. Full Technological Certificate.**—For the Full Technological Certificate the Candidate must qualify as stated in Rules 29 and 30 of the Programme. Candidates are recommended to qualify by passing the Examinations of the Board of Education in Stage II. of the subjects, II. "Machine Construction," and XXII. "Heat Engines."

**III. Works of Reference.**—"The Motor Manual" (Temple Press, Ltd., 1s. 6d.); "Electric Ignition for Motor Vehicles," by Hibbert (Whittaker & Co., 1s. 6d.); "Petrol Motors and Motor Cars," by F. Strickland (Griffin, 16s.); Carburettors, Vaporisers and Distributing Valves," by E. Butler (Griffin); "Motor-car Mechanism and Management," by W. Poynter Adams (Griffin); "The Practical Design of Motor Cars," by James Gunn (Edward Arnold, 10s. 6d.); "High Tension Magneto Ignition Systems" (Automotor Journal, 2 vols., 2s. each).

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## 75.—EMBROIDERY.

The Examination will be Written and Practical, and so arranged as to test the candidates' skill, taste and knowledge of the craft of embroidery.

There will be two grades; Certificates will be awarded on the results of each Examination, and candidates who pass will be arranged in two divisions.

The Examinations in both grades will include:—

(1.) *Practical Work* done by the candidate in the presence of the Local Superintendent.

(2.) *Written* answers to simple questions illustrated by drawings.

(3.) *Specimen Work* done by the candidate in class or in her home during the year preceding the Examination.

In order to obtain a Certificate in either grade, a candidate will be required to pass in each part 1, 2 and 3.

The material for the Practical Examination will be supplied by the Institute, but when embroidery frames are necessary they should be provided by the candidate or the school, and candidates should be instructed to bring with them to that Examination needles, thimble, scissors, pins, cord or tape and webbing, pounce and powder, and to the Written Examination pencils and water colours, a 12-inch rule, tracing paper and compasses.

**I. Syllabus.**—In the Practical and Written Examinations, the candidates will be required to answer questions and execute work in the following subjects:—

#### GRADE I.

1. *Handwork.*—Various materials, close or open mesh, such as:—Linen, damask, twill, woollen, silk, &c., Linen thread, flax, wools, filoselle, filofloss, floss, &c. Stitches used in darning, stitches for canvas, outline or stem, chain, knots and knot, buttonhole, herringbone, long and short, satin, backstitch, cross, tent-stitch, oriental stitch, &c. White work in relief. Simple cut and drawn work.

2. *Framework.*—The kind of work best done in a frame. Various materials, such as:—Linen, velvet, satin, silk, damask, &c. Methods of work and stitches used, shading and blending, laidwork, appliqué, inlay, couching, tape and braid work with insertion stitching, &c.

3. *Mounting and making up.*

4. *Tracing* and transfer of designs or patterns to materials; adaptation of designs. Preparation, from diagrams supplied, of working drawings, such as would be required for embroiderers with specifications of material and stitches.

(1.) **Practical Examination.**—A practical test of skill and taste. Five hours will be allowed for this test, which will be held on Saturday, May 18th, from 2.30 to 7.30.

(2.) **Written Examination.**—The Examination will include questions on work in the Syllabus to be illustrated by drawings. Three hours will be allowed for the Examination, which will be held on Thursday, May 2nd, from 7 to 10 p.m.

(3.) **Specimen Work.**—Candidates will be required to submit one or more specimens of their work executed in the year preceding the Examination. The specimens should show the specific purpose for which they are intended, and must be accompanied by a working drawing or drawings. The required Certificate or Declaration (see p. 300) certifying that the work was executed by the candidate herself without assistance must be sent with the work.

For instructions as to the forwarding of Practical and Specimen Work see p. 301.

The fee for Examination in Grade I is *Three Shillings and Sixpence*.

#### FINAL EXAMINATION.

The examination will comprise advanced work and questions on subjects included in the preceding Syllabus, in advanced craftsmanship, in the adaptation of design, and in the history of the craft, including such subjects as the following :—

1. *Hand and Frame work* for both domestic and ecclesiastical purposes. Use of and methods of using gold and silver thread work, "passing," purl, bullion, gimps, spangles, jewels, pearls, etc. Raised and couched work, padding, quilting. Figure work. Cut and drawn work. Carrickmacross, cut linen, guipure, appliqué, Limerick "Run" laces.

2. *Mounting and making up*.

3. *History*.—Materials, etc., used by different nations at different periods, and the various methods employed in using and embellishing them.

4. *Design*.—Adaptation and fitness of design. Stitches and methods of work in relation to materials and purpose. Selection and arrangement of colour. Symbolism of form and colour, signs and emblems, heraldic devices, lettering, monograms, etc.

(1.) **Practical Examination**.—The test will be of a more advanced character than in Grade I. Five hours will be allowed, and the test will be held on **Saturday, May 18th**, from 2.30 to 7.30 p.m.

(2.) **Written Examination**.—More advanced questions and exercises will be set than in Grade I, and candidates will be expected to show more skill in drawing and in the adaptation of design. The Examination will be held on **Thursday, May 2nd**, from 7.0 to 10.0 p.m.

(3.) **Specimen Work**.—The candidate will be required to submit a specimen of her work designed and executed during the year preceding the Examination for some specific purpose ; it must be accompanied by a working drawing.

Class Students who have executed their work in class under the eye of the Teacher, but without her help, must forward with their work a Certificate signed by the Teacher of the Class to the effect that the work has been done entirely by the Student herself. Candidates who have not done the work in Class must send in a Statutory Declaration certifying that the work is wholly their own.

Forms for the Certificate or Declaration may be obtained from the Department.

The work done at the Practical Examination (1) together with the specimen work (3) must be packed in a strong wooden box and forwarded *Carriage Paid* to London immediately after the Practical Examination.

The candidates' answers must be forwarded as soon as the Written Examination is over.

The fee for the Final Examination is *Five Shillings*.

**II. Full Technological Certificate.**—For the Full Technological Certificate candidates will be required to have qualified for a Certificate at the Final Examination and, in addition, to have passed the Board of Education Examinations in two of the following subjects:—Freehand Drawing, Geometrical Drawing (Art), Memory Drawing of Plant Form, Design Stage I., Principles of Ornament or Historic Ornament.

**III. Works of Reference.**—"La Broderie du onzième siècle jusqu'à nos jours," by M. L. de Farcy (1890 and Supplement, 1900, to be obtained from the author, 23, rue du Canal, Angers); "English Embroidery," by A. F. Kendrick (Newnes); "Needlework as Art," by Lady Marion Alford (Sampson Low, 1886); "Broderie et Dentelles," by Ernest Lefébure (Paris, 1887)—English Translation by Alan S. Cole; "Embroidery and Lace" (H. Grevel & Co., 1888); "Illustrated Catalogue of English Embroidery" (Burlington Fine Arts Club, 1905); "Samplers and Tapestry Embroideries," by Marcus B. Huish (Longmans, Green & Co., 1900); "Embroidery" (Messrs. Pearsall).

## 76.—ENGRAVING FOR CALICO PRINTERS.

**I. Syllabus.**—The Examination will include questions founded on such subjects as the following:—

### GRADE I.

1. *Sketch-making.*—(a) The geometrical basis of design, (b) drawing in relation to "Indents," (c) the one-hundredth part scale and its use, (d) the enlarging camera, (e) simple arrangements of pin-settings and repeats.

2. *Zinc-Cutting.*—(a) Allowances and saves for simple styles of work, (b) gravers applicable thereto, (c) tempering the graver and setting same in handle.

3. *Pentagraph.*—(a) Setting the roller on spindle, (b) index-wheel and micrometer, (c) setting levers for single-bar cradle machines, (d) tracing and pitching.

4. *Hand Engraving*.—(a) Mending, outlining, picking and dragging, (b) chisels and gravers, (c) punching and chiselling.

5. *Die-making*.—(a) Grounding and finishing from Penta-die, (b) tool-making for simple punches.

6. *Clamming*.—(a) Preparing round and flat dies, (b) raising the mill, (c) casehardening.

7. *Mill Engraving*.—(a) Marking on for garment cylinders, (b) bump, straight, round and link work, (c) sinks.

### FINAL EXAMINATION.

1. *Sketch-making*.—(a) Practicability of the design, (b) colour scheme, (c) selection of method for engraving, (d) pin-settings, (e) handkerchief plans.

2. *Photography*.—(a) Hand and pentagraph work, (b) methods and chemicals.

3. *Zinc-Cutting*.—(a) Allowances and saves for various styles of work, (b) zigs and pins, (c) tooth gravers.

4. *Pentagraph*.—(a) Double, back and front bar cradle machines, (b) flat table machines, (c) grounds for various etches, (d) handkerchief work.

5. *Hand Engraving*.—(a) Setting out cylinders, photo prints and various sketches, (b) pin and stipple work, (c) tooth gravers, (d) fall-on effects.

6. *Die-Making*.—(a) Traverse sketches from various pins, (b) etching dies and acids suitable thereto, (c) tool making.

7. *Clamming*.—(a) Suitable metals, (b) resinking, (c) raising punches and ruling mills.

8. *Mill Engraving*.—(a) Spiral and crossover work, (b) gearing suitable thereto.

9. *Etching*.—(a) Varnishing and ruling, (b) making varnishes and testing acids.

10. (a) Repairing, (b) turning and polishing the cylinders.

11. (a) Impressioning, (b) making up pastes and colours.

12. Office work and calculations of costs.

The Examination in both grades will be held on Thursday, May 2nd, from 7 to 10 p.m. The fee for examination in Grade I is *One Shilling and Sixpence*, and for the Final Examination *Two Shillings*.

II. Full Technological Certificate.—For the Full Technological Certificate, the Candidate will be required to qualify as stated in Rules 29 and 30, but certificates showing that he has passed the Examinations of the Board of Education in Geometrical Drawing, as well as in Freehand or Model Drawing, will be accepted in lieu of one of the Science Certificates.

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## 77.—ENGINEERS' QUANTITIES AND ESTIMATING.

I. Syllabus.—The examination will include questions founded on such subjects as the following :—

### GRADE I.

1. Technical mensuration. Modern time-saving methods of calculation. Logarithmic calculation. Use of the slide rule. Computing scales. Squared paper. Metric system.

2. Calculation of weights. Rough and finished dimensions and allowances to be made for machining. Running out weights for engines, boilers, tanks and machinery generally, and for any of the various manufactures—simple or complex—with which the engineer has to deal. Getting out the quantities for a quotation. Ordering up of material—rough or finished—when not in stock, or which it is not desired to manufacture in the works.

3. Raw material commonly used in engineering practice. Market forms of iron and steel, metals and alloys. The standardisation of machinery, of machines and engine parts and various engine details. The British Standard Specifications of the Engineering Standards' Committee.

4. Division of costs :—Material, labour, shop charges, and establishment charges and methods of dealing with them.

5. Cost of material :—Raw material, merchant bars, forgings, castings, &c.

6. Estimation of workmanship and cost of labour.

7. Cost of transit :—railway and shipping rates.

8. Preparation of quantities and estimates :—Estimating and tendering, scientific and rough and ready methods.

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The examination in both grades will be held on Wednesday, May 1st, from 7 to 10 p.m. The fee for examination in either grade is *One Shilling and Sixpence*. Candidates should bring to the examination tables of logarithms and slide rules.

## FINAL EXAMINATION.

In the Final Examination more difficult questions will be set in the above subjects, and, in addition, a knowledge will be required of :—

1. The Time Office and time keeping—time sheets and job tickets.
2. Preparation of specifications—detailed and general. Penalty clauses. Estimating and tendering for boilers, engines and machinery generally. Repair work and breakdowns. Specialities. Contracts—Home and Foreign.
3. Profit—how made and regulated. Engineering cost accounts. Order books. Stores books. Invoice books. Wages books. Summaries. Profit and loss accounts.
4. Use of squared paper for the plotting of results and the exhibition of data in connection with the Drawing Office, the Estimating Department and the Works Manager's Office.
5. Stock taking. Inventory of buildings and plant. Filing and indexing engineering literature, correspondence, quotations, &c. Card index and other systems for filing. Depreciation. Interest. Replacement and scrapping of machinery. Insurance of buildings and workmen. Compensation Acts.

II. Full Technological Certificate.—In order to obtain the Full Technological Certificate Candidates will be required to have passed the Final Examination, and, in addition, to have passed the Board of Education Examinations in Stage II. of Machine Construction and in Stage I. of Practical Mathematics.

## 78.—STRUCTURAL ENGINEERING.

The instruction in Grade I of this subject should be definitely understood to be preparatory to that for the Final Examination. In the latter too much attention should not be directed to any one branch of Structural Engineering, since the instruction should aim at supplying a general knowledge beyond which a specialist may extend his knowledge as opportunity occurs. Care should, therefore, be taken not to give too great prominence to any one subject such as bridges, cranes, or tall buildings, or to permit the teaching of such special subjects to replace the general instruction. A knowledge of such special branches is best obtained later by a student who has been well grounded in fundamental principles.

I. Syllabus.—The examination will include questions founded on such subjects as the following :—

## GRADE I.

1. *Loads on structures.*—Weights of various materials of construction. Dead and live loads. Wind pressure in ordinary cases

2. *Bending moment*.—The calculation and graphical illustration by scale diagrams of bending moment due to simple cases of loading, as, for example, systems of concentrated loads, uniformly distributed load and uniform load over a portion of the span, in the case of simply supported girders.

3. *Shearing force*.—Diagrams of shearing force corresponding with the above cases of bending moment.

4. *Moment of resistance*.—Calculation of exact and approximate moments of resistance for girders of simple sections. Graphical method of estimating moment of resistance for girders, rolled joists and troughing. The relation between moment of inertia, radius of gyration and moment of resistance of a girder section.

5. *Practical details*.—Details of riveted joints, practical arrangement of plates, joints and riveting in the simpler forms of plate and lattice girders.

The necessity for observing economy by the adoption of certain practical details and not adhering too closely to theoretical design.

Calculation of efficiency of simple riveted joints.

6. *Roof trusses*.—The various types of V trusses, and spans for which they are suitable. Calculation of stresses due to dead load by method of sections, and the obtaining of stresses by means of stress diagrams. Wind pressures : wind stress diagrams.

Detailed arrangement of joints in simple trusses.

7. *Girders*.—The general method of designing a plate girder for a given span and load.

The stresses in braced girders of uniform depth under dead loads.

8. *Masonry structures*.—Retaining walls and small span arches. Foundations for brick and masonry walls. Safe pressures on foundations in different classes of earth. Intensity of pressure on foundations of retaining walls. Line of resistance or resultant pressure in retaining walls and masonry dams.

9. *Materials*.—A general knowledge of the properties and strengths of stone, brick, cement, mortar, concrete, cast iron, wrought iron and steel.

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#### FINAL EXAMINATION.

In the Final Examination more difficult questions will be set in the subjects of Grade I and, in addition, a knowledge will be required of the following :—

1. *Loads*.—Rolling loads and their effect on structures, as distinguished from that of dead loads. Dynamic or "impact" effect, and suitable allowances therefor at varying speeds.



2. *Bending moment*.—Bending moment diagrams for cantilevers, fixed girders and continuous girders. The theorem of three moments and its graphical solution by the aid of “characteristic points.”

3. *Shearing force*.—Shearing force diagrams corresponding with the above cases of bending moment; maximum and mean shear on a girder section. The determination of principal stresses on structures.

4. *Deflection of girders*.—Method of calculating deflection or obtaining the same by graphical methods in the case of beams of uniform section under various conditions of loading. Discrepancy between theoretical and actual deflection in practical structures. Elastic deflection and deflection due to “set” of built-up riveted structures. Maximum amount of deflection desirable in various structures. Camber.

5. *Braced girders*.—Stresses in braced girders of varying depth, such as the lattice bow, N or Linville truss, Pratt truss, Baltimore truss, various types of bowstring girders and cantilevers of varying depth, under dead and rolling loads.

A more intimate knowledge of the relative economy of various types. Economical depth and span. Dead weight of girders.

Relative advantages and disadvantages of riveted and pin-connected structures.

6. *Details of ordinary types of bridges*.—The various types of flooring in general use, such as troughing, cross-girders with or without longitudinals, flat, curved and buckled floor plates, and their weights. Types and weights of permanent way in railway-bridges, and of pavements, jack arching and troughing for highway bridges.

Deflection and expansion bearings for long spans.

Detailed connections for struts and ties in large braced girders.

Overhead wind bracing and sway bracing.

7. *Wind Pressure*.—Stresses due to lateral wind pressure, both on the stationary structure and moving load. Great importance of wind pressure on large and lofty structures. Some knowledge of results of experiment on wind pressure.

8. *Roofs*.—The stresses in other types of roofs, such as “ridge and furrow,” cantilever roofs and arched roofs of large span.

Detailed construction of same.

9. *Long Compression Members*.—The theory of column strength. Columns under eccentric and central loads. Impossibility of securing ideal conditions for exact central loading in practice. Results of actual tests on full-sized columns. Discrepancies

between theory and "practical" formulæ based on results of tests. Round-ended, flat-ended, and fixed-ended columns.

Columns of special design for accommodating crane-girders on one or both sides at different heights, together with roof girders.

Design of long struts in large braced structures.

Long crane jibs and legs of high piers.

Grillage foundations for tall pillars.

10. *Arches*.—The three-hinged arch under various loadings. The disadvantages attending the use of two-hinged and rigid arches of large span, with some knowledge of the theory of the same.

11. *Suspension Bridges*.—The stresses in the flexible and stiffened types of suspension bridges.

12. *Materials and Costs*.—A more intimate knowledge of the strength of materials. Suitable specifications for materials for various works, and tests for same. A general knowledge of the probable cost of different parts of a structure under average conditions of site, supply, transport and erection.

The best methods of protecting stone, iron and steel from weathering and corrosion.

13. *Ferro-Concrete*.—A general knowledge of the principal systems of ferro-concrete construction, as applied to buildings, arched bridges, tanks, piles and conduits. Simple calculations of such structures, in so far as they may be calculated with any degree of accuracy. The beam theory as applied to ferro-concrete beams and floors. Strength of ferro-concrete piles. Materials and specifications for ferro-concrete.

The Examination in both Grades will be held on **Monday, April 29th**, from 7 to 10 p.m. The fee for the Examination in either Grade is *One Shilling and Sixpence*.

II. *Full Technological Certificate*.—For the Full Technological Certificate, the candidate must qualify as stated in Rules 29 and 30.

III. *Works of Reference*.—Rankine's "Applied Mechanics," (Griffin, 12s. 6d. nett); Cotterill's "Applied Mechanics," (Macmillan, 18s.); Perry's "Applied Mechanics," (Cassell, 7s. 6d.); Woods' "The Theory of Structures," (Arnold, 10s. 6d.); Andrew's "The Theory and Design of Structures," (Chapman & Hall, 9s. nett); Ewing's "Strength of Materials," (Pitt Press, Cambridge, 12s.); Morley's "Strength of Materials," (Longmans, 7s. 6d. nett); Unwin's "Materials of Construction," (Longmans, 16s. nett); Woods' "Strength and Elasticity of Structural Members," (Arnold, 10s. 6d. nett); Rivington's "Building Construction," 4 volumes,

(Longmans, 52s. nett); Mitchell's "Building Construction, Advanced Stage, (Batsford, 4s. 6d. nett); Brightmore's "Structural Engineering," (Cassell, 10s. 6d. nett); Warren's "Engineering Construction in Iron, Steel and Timber," (Longmans, 16s. nett); H. Fidler's "Notes on Construction in Mild Steel," (Longmans, 16s. nett); Johnson, Bryan and Turneure's "Theory and Practice of Modern Framed Structures," (Chapman and Hall, 42s. nett); Davie's "Theory and Practice of Bridge Construction," (Macmillan, 12s. nett); C. Fidler's "Bridge Construction," (Griffin, 30s.); Burr and Falk's "Design and Construction of Metallic Bridges," (Chapman and Hall, 21s. nett); Greene's "Bridge and Roof Trusses and Arches," 3 volumes, (Wiley, 26s. 6d. nett); Merriman and Jacoby's "Roofs and Bridges," 4 volumes, (Wiley, 42s. nett); Marsh and Dunn's "Reinforced Concrete," (Constable, 31s. 6d. nett); Buel and Hill's "Reinforced Concrete Construction," (Constable, 21s. nett); Twelvetree's "Concrete Steel," (Whittaker, 6s. nett); "Concrete and Constructional Engineering"—bimonthly periodical, (published at Dewar House, Haymarket, London, S.W.)

## 79.—HEATING AND VENTILATION.

I. Syllabus.—The examination will include questions founded on such subjects as the following :—

### GRADE I.

Heat and its measurement. Air and its properties. Calculation of the volume and the weight of gases corresponding to given conditions of pressure and temperature. Moisture in the air. Impurities in the air. Filtration.

The general problem of ventilation. Natural and artificial ventilation of buildings: the relative advantages and disadvantages of each. Details of apparatus used in natural and mechanical ventilation.

Flow of fluids in pipes and ducts with loss of head due to friction, bends and eddies. Sizes of pipes for a given discharge. Calculation of the size and capacity of ducts, chimneys and extracting shafts. Methods of construction: joining and connecting cast iron, wrought iron, steel, brass, copper and galvanised iron pipes. Methods of running pipes in slings, on brackets and in trenches, with constructional details. Stop valves and fittings.

Methods of warming buildings. Pipe mains. Open fires and closed stoves, gas fires, electric radiators and indirect heating by hot air or steam. High pressure hot water heating. Low pressure hot water heating. Steam heating.

## FINAL EXAMINATION.

The subjects of Grade I will be treated more fully, and, in addition, questions may be set on such subjects as the following:—

Radiation from metallic and painted surfaces, conductivity, and, in particular, the calculation of heating surface required to maintain a given difference of temperature between the inside and outside of a building from a drawing or general specification of the structure.

Methods of testing air for the presence of impurities, and calculation of air supply required to maintain a given state of purity. Humidity of air and methods of producing it.

Theory and construction of ventilating fans. Power calculations.

Details of methods used in steam heating, with calculations regarding sizes of boilers to be provided for given surfaces. Special problems regarding the removal of dust in flour mills, grinding shops, saw mills and cloth finishing factories.

The Examination in both Grades will be held on Wednesday, May 1st, from 7 to 10 p.m. The fee for the Examination in either Grade is *One Shilling and Sixpence*.

II. Full Technological Certificate.—For the Full Technological Certificate, the candidate must qualify as stated in Rules 29 and 30.

III. Works of Reference.—Baldwin on "Heating," Billings' "Ventilation and Heating," Carpenter's "Heating and Ventilating Buildings," Griffiths' "The Plenum or Propulsion System of Heating and Ventilation" (Simpkin, Marshall & Co.), Hood and Dye's "Warming Buildings by Hot Water," Thomas' "The Ventilation, Heating and Management of Churches and Public Buildings" (Longmans), Innes' "The Fan" (Technical Publishing Co.).

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## REGULATIONS FOR THE AWARD OF TEACHERS' CERTIFICATES.

### MANUAL TRAINING.

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#### WOOD-WORK AND METAL-WORK.

With the view of certifying to the efficiency of teachers to give instruction in Wood-work or Metal-work as branches of Manual Training, the City and Guilds of London Institute is prepared to issue Certificates to persons possessing the necessary qualifications.

The Institute's Certificate is accepted as a qualification for teaching by the Board of Education, Whitehall; by the Scotch Education Department, and by the Department of Agriculture and Technical Instruction for Ireland.

To obtain the Teacher's Certificate in either branch of Manual Training, in Wood-work or Metal-work, Candidates will be required :—

1. To produce evidence of having received adequate training.

As a rule Candidates must have received instruction in a School or class registered or approved by the Institute.

In order that a class may be registered it must be under the direction of a Local Education Authority, or of the Committee of a Technical School or Training College, or other public body, and the qualifications of the Instructor and the time-table of the course must be approved by the Institute. Applications for registration must reach the Department not later than Saturday, October 7th, 1911 (see Regulations 1 and 2). In certain cases, attendance at Courses of Instruction in Foreign Schools, approved by the Institute, during the year preceding the examination will be accepted as qualifying Candidates for the Examination.

2. To pass two examinations with at least a year's interval between them. No Candidate will be admitted to the Final Examination who has not previously passed the First Year's Examination.

The Teacher's Certificate will be granted on the results of the Final Examination only. No Certificates will be given on the results of the First Year's Examination, but the successes of the Candidates will be notified to the Secretary of the centre at which they were examined.

Candidates of not less than 23 years of age who have passed the First Year's Examination and can produce evidence of having taught or assisted in the teaching of either subject, to the satisfaction of the Inspector of the Board of Education or of a Responsible Officer of the Local Authority for a period of at least

Secondary Day School, will for the present be admitted to the Final Examination in that subject on payment of a special fee of *Two Pounds, without attendance at a registered class*. Should any such Candidate fail to pass the Examination, or pass in the second class, he will be admitted to the next subsequent Examination without payment of an additional fee, or to any later examination within five years by payment of a fee of £1.

The Practical Tests, which form part of the Examination, may be held in any approved School or Workshop at which the necessary arrangements can be made, including the supervision of the Candidates. Tools required must be provided by the School Committee, or the Candidates must bring them to the Examination. The material will be supplied by the Institute.

When the Workshop will not accommodate all the Candidates at one time, they may be examined with the permission of the Institute in two shifts, say, from 10 till 2 and from 2 till 6.

### WOOD-WORK.

The conditions under which Candidates are admitted to the Examination for Teachers' Certificates in Wood-work vary with the qualifications and previous training of the Candidate. They may enter accordingly under Scheme A or Scheme B.

#### SCHEME A.

The following classes of Candidates, satisfying the required conditions as to training, are eligible for examination under Scheme A.

(1.) Persons holding the Elementary School Teachers' Certificate of the Board of Education under Schedule 1 of the Code.

(2.) Masters in Secondary Schools, provided they satisfy the following conditions :—

Each Candidate will be required to produce a Certificate from the Headmaster of a Secondary School, periodically examined and inspected by a recognised authority, to the effect (i.) that he has given instruction in that School in any of the obligatory subjects of the curriculum for Secondary Schools, named in Article 7 of the Regulations of the Board of Education,\* for not less than twelve hours a week during at least one school session, to the satisfaction of the Headmaster; (ii.) that he has a competent knowledge of methods of instruction; (iii.) that he is capable of maintaining class discipline.

Each application will be considered on its merits.

(3.) Pupil Teachers undergoing a special course of training with the view to becoming Manual Instructors.

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\* Regulations for Secondary Schools, 1909.

The course of training must be under the direction of a Local Education Authority, and must comprise instruction in English, and in Drawing, in addition to Technical subjects. Full particulars of the subjects and arrangement of hours of instruction must be submitted for the approval of the Institute at the commencement of the course, but not later than Saturday, October 7th, 1911.

Pupil Teachers undergoing such a course will be admitted to examination in or after their second year's course of instruction, provided they have obtained a pass in the Elementary Stage of Practical Plane and Solid Geometry, and either Certificates in Model Drawing, Drawing in Light and Shade from a Cast and Geometrical Drawing (Art) (or the Elementary Drawing Certificate formerly issued) or a Certificate in Stage I. of Building Construction or Machine Construction in the Examinations of the Board of Education.

(4) Students of Training Colleges receiving Instruction under Teachers approved by the Institute.

The course of instruction of such students may extend over a period of more than two years. As in the case of other Candidates, they will be required to have received at least forty hours' practical teaching prior to each Examination, but not necessarily in the year preceding the Examination.

Such students will only be admitted to the Examination at or near the end of their Training College course.

(5) Uncertificated Teachers, who have been recognised by the Board of Education as Student Teachers, and have attended during the session preceding the Examination a course of Manual Training (Woodwork) approved by the Institute.

(6) Persons holding the Art Class Teachers' Certificate of the Board of Education who can produce evidence of having been engaged in teaching for at least one school session.

#### FIRST YEAR'S EXAMINATION.—SCHEME A.

Candidates will be required to produce evidence of having regularly attended, during the session preceding the Examination, a course of at least twenty lessons, each of two hours' duration, given on separate days, in a School or class registered or approved by the Institute. The lessons must include drawing and practical Wood-working of the type adapted to pupils in Public Elementary Schools. Candidates who have attended such course and failed to pass, or passed second class, will be admitted to the next subsequent examination after twelve additional lessons in the session immediately preceding the Examination.

SYLLABUS.—The Examination held at the end of the First Year's course of instruction consists of (1) Practical Exercises in Wood-working, (2) Drawing.

(1.) *Wood-working*.—Candidates will be provided with suitable sawn pieces of wood, and will be required to reduce them by the plane, saw, spokeshave, gouge, or chisel to any simple straight or curved forms specified by dimensioned sketches or printed description. They may also be required to construct from such pieces of wood any of the simpler joints, or any very simple combination of such joints to dimensioned sketches or printed description. Dimensions may be given in English or in metric measurements.

(2.) *Drawing*.—Candidates should have clear notions regarding the accurate representation of solids on a flat sheet of paper. The nature of the following kinds of projection should be understood.

(a.) *Orthographic Projection* (plan, elevation, section) in which the projectors are at right angles to the plane of projection.

(b.) *Oblique Projection*, or conventional perspective, in which the projectors are parallel to each other, but *oblique* to the plane of projection.

Candidates will be required to show ability to draw accurately to scale, in plan and elevation, simple solids and some of the simpler joints, such as *housing, angle bridle, open mortice and tenon, dove-tail halving, lap halving, &c.*; also very simple frames or combinations of joints. The joints may be drawn in their simplest positions, compatible with the clear representation of their form and dimensions.

Candidates must also show ability to represent simple joints in oblique projection, the plane of projection being parallel to one set of the principal faces of the object, so that the projection shows the true shape of these faces. Oblique projections, being intended to be pictorial views, may be simply neat freehand sketches.

To pass the Examination, Candidates must satisfy the Examiners in each of the Subjects (1) and (2).

#### SCHEME B.

The Examination under Scheme B is intended mainly for artisans, but is open to other persons.

Candidates entering under Scheme B will be eligible for the First Year's Examination *without having necessarily attended a registered class*. They will be required, however, before presenting themselves for that Examination, unless they hold the Institute's Teacher's Certificate in Manual Training, Metal-work, to have passed the Institute's Examination in one of the following subjects:—

Mechanical Engineering, Grade II, Section B (Pattern Making).

Carpentry and Joinery, Grade II.

Ship Builders' Work, Section A or B, Grade I.

Cabinet-Making, Grade I.

Carriage Building (Road or Rail), Grade I.



Where the necessary arrangements can be made, the Examination in one of the foregoing subjects may be taken concurrently with the First Year's Examination in Manual Training.

#### FIRST YEAR'S EXAMINATION.—SCHEME B.

SYLLABUS.—The Examination will include (1) Wood-working, (2) Drawing (for syllabuses *see* under Scheme A, *above*) and also (3) a simple Literary Test.

(3.) *Literary Test.*—Candidates will be required to answer a few simple questions, as a test of their ability to express their ideas clearly and concisely in correct English. Not more than one hour and a half will be allowed for this part of the Examination, and the Questions will be restricted to matters with which the Candidates should necessarily be well acquainted.

Candidates under Scheme B who have passed the Honours Grade Examination in Carpentry and Joinery in 1899 or subsequently, or the Full Examination of the Carpenters' Company, will be exempted from the practical test in Wood-working.\*

#### FINAL EXAMINATION.—SCHEMES A AND B.

Candidates for the Final Examination must have previously passed the First Year's Examination, and must have attended during the session preceding the Examination a course of at least twenty lessons, at a school or class registered or approved by the Institute. The lessons must include instruction in the principles and practice of wood-working as adapted to the teaching of pupils in Public Elementary Schools, as well as drawing and the subjects of the Written Examination. Candidates who have attended such course and failed to pass, or passed second class, will be admitted to the next subsequent examination after twelve additional lessons in the session immediately preceding the Examination.

Candidates who have passed the First Year's Examinations under Scheme B will also be required at the time when they make application for the Final examination to produce evidence of having taught or assisted in the teaching of the subject, to the satisfaction of the Inspector or other responsible Officer of the Local Authority, for not less than 150 hours within a period of not more than two years, in a Public Elementary or Secondary Day School.

SYLLABUS.—The Examination will consist of (1) More advanced exercises in Wood-working, (2) Drawing, and (3) Questions on the Technology of wood-work and Methods of Instruction.

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\* Candidates may take the Final Examination in Carpentry and Joinery concurrently with their First Year's Examination in Manual Training, and for such candidates the Practical Test in Carpentry will be accepted in lieu of the Practical Test in Manual Training.

(1.) **Wood-working.**—Exercises similar to those for the first year, but more difficult. Dimensioned sketches will be given as a guide to what is required, or printed description.

(2.) **Drawing.**—Making freehand sketches of, and drawing to scale from dimensioned sketches, ordinary joints used in wood-work, or any simple frames or simple framed objects made of wood.

Hand sketches of simple joints and frames as seen in oblique projection.

(3.) **The Written Examination** will occupy four hours and will be held in two parts—*Part I* containing questions on the technology of the subject and on the equipment of the Manual Training room, and *Part II*, questions on the methods of manual instruction in wood-work and on class management.

The Course of instruction preparatory to the Written Examination should consist of explanations and practical demonstrations of the methods of teaching the use of tools to young children, and explanations of the sequence of wood-working and corresponding drawing lessons, as indicated in the following Syllabuses :—

#### *Part I.*

1. The Manual Training Class-room—its equipment for efficient teaching—estimated cost of apparatus, tools, timber, &c.—the proper upkeep of tools and apparatus.

2. The classification and description of Manual Training tools—illustration by hand-sketches—reasons prompting the selection of certain tools for Manual Training purposes and the rejection of others—the importance of educational sequence in the introduction of tools in a course—the mechanical principles underlying the construction and manipulation of tools, as an aid to the teaching of Mechanics—the historical development of tools.

3. The Timber Tree—its geographical distribution—its growth—its diseases—the classification of timber trees—history of the timber tree from the forest to the bench—the characteristic properties (including specific gravity) and uses of the commoner timbers—methods of preserving timber from the effects of climate—seasoning, shrinkage.

4. The various methods of fastening employed in wood-work, leading to the consideration of wood-work joints, screws, nails, glue, &c.

#### *Part II.*

1. The character of manual instruction and sequence of lessons suitable for children of different ages. The preparation of schemes of work to meet the requirements of schools of various types.

2. Class management, arrangement of pupils, use of blackboards, diagrams, and note-books. The special characteristics of various systems of teaching the subject.

3. The preparation of notes of lessons on any of the subjects

4. General principles of teaching, the recognised methods of presenting the material to the pupil; methods of stimulating observation, enquiry, and self-reliance; the application of approved methods of teaching to handicraft subjects. The objects of manual training and their relation to those of the general school curriculum.

The literary ability of the Candidates, as shown in answering their questions, will be taken into consideration in the award of marks.

To obtain a Certificate, Candidates must pass in each of the three sections of the Examination (1), (2), and (3).

**Works of Reference.—Drawing.**—"Practical Plane and Solid Geometry," Elementary by J. Harrison, and Advanced by J. Harrison and G. Baxendall (Macmillan & Co.); "Manual Training-Drawing," by S. Barter (Whittaker & Co.). *Schemes of Woodwork.*—"Manual Instruction-Woodwork," by S. Barter (Whittaker & Co.); "Manual Training for the Standards," by C. Young; "Woodwork," by J. T. Baily and S. Pollitt—Murray's School Library; "New Education-Manual Training Woodwork," by R. Wake (Chapman & Hall); "Manual Training for the Standards," by C. Pearson, Liverpool; "Theory of Sloyd" and "Teacher's Handbook of Sloyd," by Otto Salomon (Philips & Son); "Learn by Doing," by J. H. Judd (E. J. Arnold & Son, Ltd., Leeds); "Principles of Educational Woodwork," by C. L. Binns and R. E. Marsden (Dent & Co.). *Timber and Timber Trees.*—"Wayside and Woodland Trees," by E. Step (Warne & Co.); "Familiar Trees," by G. S. Boulger (Cassell & Co.); "Wood," by G. S. Boulger (Arnold); "The Timbers of Commerce," by H. Stone (W. Rider & Son); "Our Native Trees," by Harriet L. Keeler (Chas. Scribner, New York). *Tools.*—"The Woodwork Scholar's Guide in the use of Tools," by C. W. Boxall (Newmann); "Evolution of Tools," in Harmsworth's "History of the World"; "From Stone to Steel," by H. S. Harrison (P. S. King & Co.). *Psychology.*—"A Text-book on Psychology" and "Talks to Teachers on Psychology," by W. James (Macmillan); "Psychology for Teachers," by Lloyd Morgan (Arnold); "The Elements of Psychology," by E. L. Thorndike (Seiler, New York). *Methods of Teaching.*—Adamson's "The Practice of Instruction" (The National Society's Depository); Welton's "Principles of Teaching" (University Tutorial Press); Adams' "Exposition and Illustration" (Macmillan).

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## METAL-WORK.

To obtain the Teachers' Certificate in Manual Training—Metal-work—candidates will be required :—

1. To produce evidence of having regularly attended, during the session preceding each examination, a course of at least twenty lessons in Metalwork designed with special reference to Manual

Training in Elementary or Secondary Schools, as distinct from a course of Practical Engineering. The lessons must be given on separate days, each lesson must be of at least two hours' duration and the school or class must be registered or approved by the Institute.

Students are reminded, however, that the number of attendances laid down in the general regulations is the minimum that can be accepted by the Institute as qualifying candidates to enter for examination; candidates with little practical experience in metal-work will probably require to have made much more than the minimum number of hours of attendance in order to prepare themselves adequately.

Candidates who have attended such course and failed to pass, or passed second class, will be admitted to the next subsequent examination after twelve additional lessons in the session immediately preceding the examination.

2. To pass two examinations, with at least a year's interval between them.

3. Before presenting themselves for the First Year's Examination, to have passed the Institute's First Year's Examination in Manual Training Woodwork; or to pass concurrently with their First Year's Metalwork Examination, the Practical Test for the First Year's Examination in Woodwork. Candidates cannot present themselves in the same year for the First Year's Examination in Woodwork and the First Year's Examination in Metalwork.

#### FIRST YEAR'S EXAMINATION.—SYLLABUS.

The First Year's Examination will consist of (1) Practical Exercises in Metalwork (2) Drawing (3) a Written Examination.

(1.) **Practical Work.**—Exercises will be given to test the candidate's ability to use the flat and cross-cut chisels, the several forms of files, drills, taps, stocks and dies, snips and other bench tools, the soldering bit and fluxes, and simple forge tools, in the manipulation of cast iron, wrought iron, steel, brass, copper, aluminium, tin plate and lead (in solid, sheet, ribbon or wire form), for constructional details. The processes will include welding, soldering, brazing, bending, riveting, annealing, hardening and tempering. Machine work other than drilling will not be permitted.

The material required for the examination will be supplied by the Institute. Measuring tools (rules, calipers, centre punches, &c.) should be brought by the candidates.

(2.) **Drawing.**—Candidates will be required to shew some knowledge of simple workshop drawing as regards machine details. The tests to be set will be selected from the following:—Freehand sketches to be made in good proportion from memory

of the simpler parts of workshop machines, tools and fittings, and of exercises in practical work.

Drawing accurately to scale from dimensioned sketches of machine details, including:—projection of screws of large size accurately to scale, shewing the Vee or the square form of thread with the projection of the helical curves; accurate projection of hexagonal nuts, assuming the chamfered surface to be conical or spherical; projection of nuts and screws by the usual approximate methods; drawing of cotters, gibs, keys and pins—bolts, screws, nuts and washers—and rivets; and of the simpler joints and parts of machinery involving their application.

(3.) **Written Examination.**—Candidates will be required to answer simple questions on the tools used and methods of procedure employed in working such exercises as are set in the practical tests, together with questions relating to the chief properties of the more common metals, and their preparation for workshop requirements. Questions will be set to test the candidate's resourcefulness and adaptability, and his general knowledge of details of mechanism and shop equipment.

Candidates must satisfy the examiners in each of the three sections of the First Year's Examination, Practical, Drawing, and Written, in order to secure a pass.

#### FINAL EXAMINATION.—SYLLABUS.

Candidates for the Final Examination must have previously passed the First Year's Examination, and must have made the required number of attendances at a class registered or approved by the Institute. Candidates are also strongly advised before presenting themselves for the Final Examination to obtain, as assistant instructors, some experience in teaching the subject.

The Final Examination will consist of (1) more advanced exercises in Practical Work (2) Drawing (3) a Written Examination. The course of instruction should include not only lessons in practical work, in mechanical drawing and in the designing of machine details, but also instruction in the subjects of the Written Examination as laid down in the syllabus below.

(1.) **Practical Work.**—Exercises may be selected from the subjects of the First Year's Syllabus but greater accuracy and finish will be expected; or more difficult exercises of a similar type (including complete models of simple apparatus) involving the principal operations of bending, riveting, brazing, soldering, forging, and turning will be set. The course of training should prepare the candidate in the use of the lathe for turning, boring, and screw-cutting; of the drilling machine for drilling, slot boring and disc cutting; of the forge for welding and simple forging; and of the plate metal work tools for soldering, seaming, embossing, &c.

(2.) **Drawing.**—Examples of more difficult parts or details of machines, tools and equipment will be given. A knowledge will

be required of the elementary principles of machine designing, and ability (a) to sketch freehand, from memory, details of mechanism and tools (b) to draw accurately to scale from sketches supplied (c) to apply the principles of geometrical projection in the delineation of surfaces and solids, and in the development of plans, elevations and sections in correct relative positions.

(3.) **Written Examination.**—The written examination will occupy four hours and will be held in two parts (i) containing questions on the technology of the subject and on the equipment of the workshop and (ii) questions on the methods of manual instruction in metalwork and on class management, as indicated by the following syllabuses :—

#### PART I.

The questions set will require a general knowledge of such subjects as the following :—Shop processes; the chief mechanical principles underlying the construction and manipulation of tools; the care and management of tools. The characteristics of the commoner metals and alloys. The usual machine tools, lathe, drilling machine, &c., their use and abuse in a scheme of school metalwork. The equipment of school class rooms for simple metalwork and of metalwork centres, including the application of power for driving machines; steam, gas engines, and electro-motors; the arrangement of shafting, pulleys and belting; speeds required for different machines. Candidates will be expected to possess a good working knowledge of the elements of applied mechanics.

#### PART II.

The questions set in this section will refer chiefly to the character of Handwork; the sequence of lessons for young people of different ages; schemes of work; arrangement of pupils of varying degrees of mental and physical capacity. Use of blackboards, diagrams, notebooks and models. Preparation, presentation and illustration of subject matter relative to metalwork. Principles of teaching. Methods of stimulating observation, enquiry and self-reliance. Application of modern methods of teaching to Handwork and correlation of this subject with the general school curriculum.

Candidates will be required to satisfy the examiners in the practical work, the drawing examination, and in both sections of the written paper.

**Works of Reference.**—"Principles of Fitting" (Whittaker & Co.); "Metal Turning" (Whittaker & Co.); "Workshop Appliances" by C. P. B. Shelley (Longmans); "Machine Shop Tools and Methods" by W. S. Leonard (Chapman & Hall, 1905); "Mechanical Engineering" by W. S. Lineham (Chapman & Hall). For works on Drawing, Psychology and methods of Teaching, see Syllabus of Woodwork, p. 316.

**Dates of Examination.**—Applications for the Registration of Classes should be received at the offices of the Department not later than **October 7th, 1911**, and a return of the numbers of students in attendance must be sent in not later than **November 4th**. Applications for examination must be received at the offices of the Department from Local Secretaries on the proper forms, accompanied by the fees and all necessary Certificates, not later than **Monday, March 25th**.

The Examinations in Manual Training for the year 1912 will be held on the following dates.

**Wood-work—First Year, Schemes A. and B. (Practical) *Saturday, May 4th, 10.0 to 2.0 or 2.0 to 6.0 p.m.***

Do. do. Scheme A. and B. (Drawing), *Wednesday, May 8th, 7.0 to 10.0 p.m.*

Do. do. Scheme B. (Literary Test) *Thursday, May 9th, 7 to 8.30 p.m.*

Do. Final (Drawing), *Wednesday, May 8th, 7.0 to 10.0 p.m.*

Do. do. (Written), *Thursday, May 9th, 6.0 to 10.0 p.m.*

Do. do. (Practical), *Saturday, May 11th, 10.0 to 2.0 or 2.0 to 6.0 p.m.*

**Metal-work—First Year (Written), *Thursday, May 9th, 7.0 to 10.0 p.m.***

Do. do. (Drawing), *Wednesday, May 8th, 7 to 10 p.m.*

Do. do. (Practical), *Saturday, May 11th, 10.0 to 2.0 or 2.0 to 6.0 p.m.*

Do. Final (Practical), *Friday, May 3rd, and Saturday, May 4th, 10.0 to 2.0 or 2.0 to 6.0 p.m. each day.*

Do. do. (Drawing), *Wednesday, May 8th, 7.0 to 10.0 p.m.*

Do. do. (Written), *Thursday, May 9th, 6.0 to 10.0 p.m.*

**Fees.**—The fees for Examination are :—

For First Year's Wood-work, *Five Shillings.*

„ Final Wood-work, *Seven Shillings and Sixpence.*

„ First year's or Final Metal-work, *Ten Shillings.*

„ Final Wood-work or Metal-work (Teachers' special), *Two Pounds.*

## DOMESTIC SUBJECTS (EVENING SCHOOLS).

## PLAIN NEEDLEWORK, DRESSMAKING AND MILLINERY.

With a view of certifying to the efficiency of teachers to give instruction in Evening Schools in Plain Needlework, Dressmaking and Millinery, the Institute is prepared to issue Teachers' Certificates to persons possessing the necessary qualifications.

To obtain the Evening School Teachers' Certificate in any one of the above-mentioned subjects, candidates must have completed their 19th year before the date fixed for the commencement of their examination and will be required :—

1. To have regularly attended immediately prior to their examination a course of instruction in a class registered by the Institute as a Teachers' Training Class, or in a recognised Training School.

In order that a class may be registered, it must be held under some Public Authority, and the qualifications of the Instructress must be approved by the Institute. The timetable of the course of instruction must also be submitted to the Institute for approval.

The complete course of instruction in Dressmaking or in Plain Needlework should cover a period of two Sessions, and should include not less than 300 hours.

In Millinery a course of instruction of not less than 200 hours will suffice.

Before presenting themselves for examination candidates will be required to have made not less than three-quarters of the total possible number of attendances, and to produce such evidence of attendance as may be required.

Students possessing some knowledge of the subject may, by permission of the School Authorities and with the approval of the Institute, enter the Second Year's Course in that subject.

Candidates who have already passed the Institute's ordinary examination (see pp. 270 to 276) in any one subject will be at once admitted to the Second Year's Course in that subject.

2. To have passed the examination of the Board of Education in Freehand Drawing in outline, or in Stage I. of Design, or the Examination in Drawing on the Blackboard formerly held, or the Examination for the Elementary School Teacher's Certificate including a test in Blackboard Drawing, or the Institute's Examination in Blackboard Drawing (p. 329).

3. To pass each of the prescribed examinations, written and practical, in the subject selected.



The examination in each subject will consist of—

(a) A Written Examination of two papers, (i.) containing questions on the technology of the subject and (ii.) on the equipment and arrangement of the rooms, and on methods of teaching the subject and on class management.

Candidates presenting themselves at the same examination for more than one subject will only be required to take one paper in the subject included under (a) (ii.).

(b) Practical Tests including specimens of the Candidate's home or class work.

The Candidate will also be required to produce evidence satisfactory to the Institute of having acquired some experience or obtained some practice in teaching, and of being able to apply the principles and methods involved in the Written Examination (a) (ii.). The Institute will accept as the required evidence a Certificate from the Instructress of a registered training class, giving full particulars of such experience or practice.

The fee for the entire examination in any one subject will be £1: this does not include the fee for the Optional Examination in Blackboard Drawing, which is *Two Shillings and Sixpence*.

Candidates who pass will be arranged in two divisions, and will receive First or Second Class Certificates accordingly.

Teachers over 21 years of age, who can produce evidence satisfactory to the Institute of having taught efficiently in a School under Inspection any one subject for a period of two school years, will be admitted to the examination in that subject without reference to the instruction they may have received. A report to the required effect from the Inspector or other responsible Officer of the Local Education Authority will be accepted as satisfying this condition. The examination fee for teachers so admitted will be £2 for any one subject and an additional fee of £1 for each extra subject if taken at the same examination.

**Registration of Classes.**—Applications for the Registration of Classes with a view to the Examinations to be held in July, 1912, should be received at the Offices of the Department not later than **Saturday, October 7th, 1911.**

**Dates of Examinations, 1912.**—The Examinations for Teachers' Certificates in the several Domestic Subjects will be held on the following dates :—

Blackboard Drawing, Monday, July 1st. Candidates will be examined in groups, commencing at 10 a.m. One hour will be allowed to Candidates taking one subject, and one hour and a-half to candidates taking more than one.

Plain Needlework (Written), Tuesday, July 2nd, 10.30 a.m. to 1.0.  
 " " (Practical), " " " 2.0 to 6.0 p.m.

Dressmaking (Written), Wednesday, July 3rd, 10.30 a.m. to 1.0.  
 " (Practical), " " 2.0 to 6.0 p.m.

Millinery (Written), Thursday, July 4th 10.30 a.m. to 1.0.

“(Practical) ” ” ” 2.0 to 6.0 p.m.

Methods of Teaching, Friday, July 5th, 2.0 to 4.0 p.m. for those taking one subject ; 2.0 to 5.0 p.m. for those taking more than one.

The Specimen Work executed by Candidates during the Session preceding the Examination must be forwarded with the work executed at the Practical Examination.

Applications for examination must be received at the Offices of the Department on the proper forms, accompanied by the fees, not later than Thursday, May 30th.

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### PLAIN NEEDLEWORK.

(1.) **Written Examination.**—The Written Examination will be in two parts, and will include questions on the following subjects :—

#### PART (i).

1. The points to be observed in cutting out calico and flannel.
2. The most suitable materials to be used for different undergarments.
3. The different systems of cutting out and reasons of preference for any one system adopted.
4. Drawing a diagram of any garment of underlinen.
5. The cutting out of garments and their construction.
6. The various stitches and processes of work used in plain needlework and their application to garments.
7. Methods of patching and darning.

#### PART (ii).

1. Outlines of lessons, with illustrations, suitable for classes of children and adults.
2. Arrangement and equipment of class-rooms.
3. Class management, use of blackboards and note-books ; use of squared paper and diagrams.
4. Scope and preparation of Courses and Syllabuses of Lessons. Means of associating class teaching with practical work.
5. Methods of stimulating observation, enquiry and self-reliance in pupil.

(2.) **Practical Examination.**—Each Candidate will be required—(1) to cut out any garment or section of a garment for underlinen *from memory*, or from given measurements, and to tack together

such portions as may be indicated at the time of the Examination ;  
(2) to work any part of the specimens in Section 3 (a), (b) or (c).

The materials for the practical Examination will be supplied by the Institute, but Candidates will be required to bring with them a tape measure, a thimble, scissors, needles, pins, pencil, sewing and crochet cotton. No other aids to examination are allowed.

(3.) Specimen Work.—Each candidate will be required, in the Session preceding the Examination, to complete, in all particulars, the work mentioned below in (a), (b), (c), and (d).

The work shown on the sampler should be such as the Candidate would use in the making of ordinary garments. The regularity of the stitches (particularly hemming and herring-boning) should be gauged by eye alone. *Exceptionally fine work is not desired, and the habit of counting threads in working should not be practised.*

(a) A calico sampler to be worked as shown in Diagram A, see plate facing p. 274, showing the following stitches and processes :—

- |                                       |   |
|---------------------------------------|---|
| 1. Hemming.                           | 12. Insertion of gusset.                          |
| 2. Sewing (or seaming) and felling.   | 13. Calico patch.                                 |
| 3. Gathers, and setting into band.    | 14. Opening as if for a chemise.                  |
| 4. Stitching, i.e., "Back stitching." | 15. Feather (i.e., Coral) stitch.                 |
| 5. Pleating.                          | 16. Sewing on tapes.                              |
| 6. Tuck run.                          | 17. Sewing on a button.                           |
| 7. Marking.                           | 18. Making a loop for button, and an eyelet hole. |
| 8. Button-hole.                       | 19. Piping.                                       |
| 9. Run and fell.                      | 20. A strengthening tape.                         |
| 10. Knotting.                         |   |
| 11. Whipstitch and setting on frill.  |   |

The materials required for the calico sampler are :—

- |  |   |
|--|---|
| 1. A piece of moderately coarse calico (12 in. by 30 in.) with even threads. | 4. Crochet cotton, No. 16 or 18, for feather stitching; flax thread may be used if preferred. |
| $\frac{1}{2}$ yd. of mull muslin for frilling.                               | 5. $\frac{1}{2}$ yd. of tape.   |
| 3. Coloured Cottons, No. 50 or finer, and No. 100 for frill (white).         | 6. $\frac{1}{4}$ yd. of piping cord.  |
|  | 7. An unpierced linen button about as large as a threepenny piece.                            |

N.B.—Coloured cotton to be used throughout to show neatness in joining.

(b) A flannel sampler to be worked as shown in Diagram B, see plate facing p. 275, showing the following stitches and processes :—

- |  |  |
|--|--|
| 1. Herring bone stitch, and two methods of making seams. | 10. A strengthening tape.  |
| 2. Hemming.  | 11. Formation of a placket hole.   |
| 3. Stitching.  | 12. Scalloping.  |
| 4. Tuck running.   | 13. Putting on strings; (a) at the edge (b) at a distance from the edge. |
| 5. Button-hole.  | 14. Putting on a button.   |
| 6. Marking.  | 15. A case for a draw string.  |
| 7. Featherstitch.  | 16. A square patch.  |
| 8. Pleating, and putting on band.                        | 17. A triangular patch   |
| 9. Putting on flannel binding.                           |  |

The materials required for the flannel sampler are :—

- |  |  |
|--|--|
| <ol style="list-style-type: none"> <li>1. <math>\frac{1}{2}</math> yard of flannel, about 28 inches wide, in which the threads can be easily seen.</li> <li>2. <math>1\frac{1}{2}</math> yards of flannel binding, about <math>\frac{1}{2}</math> inch in width.</li> <li>3. A piece of calico (12 in. by 4 in.).</li> <li>4. A linen button ; <math>\frac{1}{2}</math> yard of tape.</li> </ol> | <ol style="list-style-type: none"> <li>5. A reel of coloured cotton, No. 40 or 50.</li> <li>6. A skein of fine flax thread, silk, or angola wools for darns.</li> <li>7. <math>\frac{1}{2}</math> yard of Briggs' transfer paper, and a skein of flannel silk for scalloping and feather-stitching.</li> </ol> |
|--|--|

(c) Darning :—

- |  |   |
|--|---|
| <ol style="list-style-type: none"> <li>1. On flannel, as if for a thin place.</li> <li>2. On material—a hedge tear.</li> <li>3. On linen—a cross cut.</li> <li>4. On stocking web, as for a thin place.</li> </ol> | <ol style="list-style-type: none"> <li>5. On stocking web, a hole as in ordinary stocking darning.</li> <li>6. On stocking web, Swiss darning.</li> </ol> |
|--|---|

The specimens in (c) should be mounted on a card.

(d) Cutting Out :—

1. A garment in calico, longcloth, or cambric, to be cut out and made up. The garment may be any size, but should include as great a variety of stitches as possible.
2. Patterns to be cut out and tacked together, to include—
  - (1) One garment for a baby.
  - (2) Two for a child or girl.
  - (3) Two for a woman.
  - (4) One for a boy or man.

The garments may be full or half size, and all measurements must be stated, and age or height given. *Four of these garments should be tacked in material and two in lined extension paper.*

3. Diagrams of the paper patterns in No. 2, drawn on sectional paper ( $\frac{1}{4}$  inch scale), and containing directions for making up.

The drawings should be arranged in a sectional book.

After the Examination of the work in London, the specimens submitted in accordance with Section (3) will be returned to the centre at which the candidate was examined.

Students must have executed their specimen work in class, under the eye of the teacher, but without her help ; and every student must produce a Certificate, to be forwarded with the work,\* signed by the teacher of the class and the Principal of the Training School or other Institution, to the effect that the work has been done entirely by the student herself. In exceptional cases, the more ordinary or mechanical part of the work, such as making seams and hems, may be done at the student's home, but, in such cases, the Declaration Form must indicate precisely the particular part of the work that has not been executed in class. Teachers over 21 years of age entering under the rule on p. 322, must forward a Statutory Declaration. Forms of Certificate and Declaration may be obtained on application.

\* The work done at the Practical Examinations in Plain Needlework, Dress-making, and Millinery Section (2), together with the Specimen work, Section (3), must be carefully packed in a wooden box, and forwarded, *carriage paid*, to the Offices of the Department immediately after each Practical Examination. The candidates' answers must be forwarded immediately after each Written

## DRESSMAKING.

(1.) **Written Examination.**—The Written Examination will be in two parts, and will include questions on the following subjects:—

1. Materials and linings (with average widths and prices) in general use for various types of dresses and suitable kinds of trimming for specified materials.

2. Calculation of quantity of material of various widths required for a dress, and cost of dress, including material, linings, trimmings, and other items necessary for finishing.

Estimates from a fashion plate or other illustration.

3. The various stitches and processes of work used in dress-making and their application to material.

4. Drafting diagrams of the various parts of a blouse or bodice to a reduced scale, and showing how the same should be cut from material and lining of given widths.

Drafting for children and girls and for irregular types of figure.

5. Drafting diagrams of skirts (plain and more elaborate in style) to a reduced scale. Planning, cutting out, making up, trimming, and completing skirts in all particulars.

6. Preparation of a bodice for fitting, and rules to be observed in fitting a bodice to a given figure.

7. Methods of making up, trimming, and generally finishing a blouse or bodice.

8. Adaptation of simple drafts to fancy styles of dress.

9. Renovating and repairing.

10. Terms peculiar to dressmaking and their meaning.

11. The method employed in elementary pattern modelling in leno.

Questions on Class Management and the Method of Teaching will be based on the subjects included in Part (ii.) of the Syllabus in Needlework, as applicable to the teaching of Dressmaking.

Candidates should bring with them an inch ruler and pencil. No diagrams or charts are allowed.

(2.) **Practical Examination.**—Each Candidate will be required to draft, cut out, and tack a bodice lining or a blouse from given measurements, with one sleeve tacked in, and to work any section (from written instructions or from a fashion plate), of a bodice or skirt which may be indicated at the time of the Examination. The materials will be supplied by the Institute.

No charts, or curved rulers, or specially graduated rules of any kind may be used during the Examination.

Candidates will be required to bring with them to the Practical Examination a tape measure, a ruler, pencil, and chalk, a tracing

wheel, a thimble, scissors, pins, needles, suitable cottons, and silk (any colour) for button holing, but no other aid to examination.

(3.) **Specimen Work.**—Each candidate will be required, in the Session preceding the Examination, to make—

(1.) A complete dress in material (not cotton). The bodice or blouse should be made up on a fitted lining, and the skirt lined or made independently from the foundation. The entire dress may be suitably (not elaborately) trimmed according to present fashion if preferred. Both bodice and skirt must be quite new and not previously worn. A slip of paper should be securely tacked to the lining of the back of the bodice and should show—

(a) A complete estimate of expenditure including quantities of material, lining, etc., which have been used in making the dress.

(b) A tabulated list of measures for bodice and skirt.

(2) A teacher's equipment, containing small specimens of work, in progress or completed, showing all stitches and processes involved in Dressmaking. These specimens should be mounted so that the samples may be conveniently detached for class illustration.

(3) Three paper patterns of skirts (drafted to  $\frac{1}{2}$  scale) and cut out *full* size suitable for materials of different widths.

(4) Two or three specimens of repairing or renovating, *e.g.*, patching and darning in a small section of a dress in which such mending might be necessary.

(5) An indexed notebook, containing—

(a) Drafts to a reduced scale.

(b) A list of materials and linings (with widths and prices) for various types of dresses.

(c) Summarised information respecting the processes of working necessary for making skirts and bodices.

Students must have executed their specimen work in class, under the eye of the teacher, but without her help; and every student must produce a Certificate, to be forwarded with the work,\* signed by the teacher of the class and the Principal of the Training School or other Institution, to the effect that the work has been done entirely by the student herself. In exceptional cases, the more ordinary or mechanical part of the work, such as tacking, machining and overcasting, may be done at the student's home, but, in such cases, the Declaration Form must indicate precisely the particular part of the work that has not been executed in class. Teachers over 21 years of age entering under the rule on p. 322, must forward a Statutory Declaration. Forms of Certificate and Declaration can be obtained on application.

## MILLINERY.

(1.) **Written Examination.**—The Written Examination will be in two parts, and will include questions upon the following subjects :—

1. (a) Materials suitable for various kinds of shapes ; (b) materials suitable for covering given shapes.

2. Methods of taking (a) measurements, and (b) patterns of hat and bonnet shapes.

3. Methods of (a) cutting out, and (b) making-up net, buckram, or espatra shapes.

4. Methods of making (a) wire shapes, (b) drawn shapes, and (c) covering buckram shapes.

5. Terms peculiar to millinery, and the various stitches involved in the manipulation of lace, velvet, wire, crêpe, &c. ; also the renovation of various millinery materials.

6. (a) Approximate statement of quantities and cost for hats and bonnets of given style and construction. (b) Suggestions for making and trimming a given hat or bonnet.

7. Methods of (a) lining and binding hats according to current fashions. (b) Cutting materials on cross, corner, straight, or to shape. (c) Making up bows, rosettes, and other general forms of trimming. The making up of children's hats and bonnets in velvet, silk, or cloth.

N.B.—Answers should be plentifully illustrated with diagrams.

Questions on Class Management and Methods of Teaching will be based on subjects included in Part (ii.) of the Syllabus in Needlework, as applicable to the teaching of Millinery.

(2.) **Practical Examination.**—The Candidate must be prepared to do any piece of practical work covered by the Syllabus. The work to be done will be stated on the Question Paper. The materials required will be supplied by the Institute.

(3.) **Specimen Work.**—Each Candidate will be required during the Session preceding the Examination to prepare the following :—

(a) A hat or toque shape to be made in sparterie, covered with cloth or velvet, and suitably trimmed.

(b) A useful toque of straw or other plait, trimmed entirely with the plait of the same or of another suitable colour.

(c) Three full-sized hat or toque shapes in sparterie, stiff net, and wire—one of each.

(d) Models showing working in straw making and covering of hat shapes and bandeaux, bows and rosettes, and other processes in Millinery.

(e) A notebook, with index, containing instructions for making patterns of hats, bonnets, &c., notes of quantities of material required for, and methods of making up bows and various trimmings which would be found useful for future reference.

Such paper patterns and measurements as may be required should be forwarded with the work.

Students must have executed their specimen work except possibly the notebook (e) in class, under the eye of the teacher, but without her help; and every student must produce a Certificate, to be forwarded with the work\* signed by the teacher of the class and the Principal of the Training School or other Institution, to the effect that the work has been done entirely by the student herself. Teachers over 21 years of age entering under the rule on p. 322, must forward a Statutory Declaration. Forms of Certificate and Declaration may be obtained on application.

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### OPTIONAL EXAMINATION IN BLACKBOARD DRAWING.

In view of the fact that the Board of Education has ceased to hold an examination in Blackboard Drawing, except as a portion of the examination for the Elementary School Teachers' Certificate, the Institute has decided to hold an examination in Blackboard Drawing adapted to the needs of Teachers of Dressmaking, Millinery or Plain Needlework, which may be taken by candidates for the above Examinations in lieu of one of the examinations of the Board of Education named in paragraph 2 on page 321. The Examination will be open (1) to candidates presenting themselves for examination for the Evening School Teachers' Certificate in Dressmaking, Millinery or Plain Needlework in 1912, and (2) to candidates who have passed the Institute's Examination in either subject in a previous session, but have not yet qualified for the necessary certificate in Drawing.

The examination is intended to test the capacity of candidates to illustrate lessons in Dressmaking, Millinery and Plain Needlework by drawing on the blackboard.

Highly finished diagrams are not required but the sketches should express the ideas they are intended to convey simply and clearly.

The drawings are to be executed upon large sheets of brown paper to be supplied by the Schools, according to a sample to be sent from the Institute, and the medium used is to be white and



possibly coloured chalk and charcoal. The drawings are to be forwarded to the Offices of the Department for examination by the Chief Examiner.

The examination will be divided into three sections. I. Object Drawing. II. Memory Drawing, and III. Scale Drawing. In each section a different question will be asked according to the subject to which the paper relates—namely, drawing for Dress-making, Needlework or Millinery.

The following statements show in greater detail the nature of the tests that will be given in Sections I, II and III.

### SECTION I.

**Object Drawing.**—The candidate will be supplied with some portion of a garment or hat and from this she will be expected to make without rule or measurement an intelligible diagram suited for class demonstration.

### SECTION II.

**Memory Drawing.**—In this section the candidate will be asked to draw from memory some object specially asked for and of a similar nature to the objects classed in Section I.

### SECTION III.

**Scale Drawing.**—For the drawing in this Section the candidate should familiarise herself with the use of 'T' and set squares, compasses and rulers. Each candidate will be given a small diagram of a similar nature to those indicated in Sections I and II but of a more elaborate character; she will be asked to make an enlargement of the same on her brown paper as if for a class demonstration.

In these drawings accuracy will be indispensable.

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**Note.**—The question of extending in future years this Examination so as to require from the Candidate some knowledge of flat patterns of simple types of garments, such as the Ancient Greek, the Japanese and Chinese, the English smock and Church vestments, will be considered by the Institute. The Examination for this year, however, will be confined to the subjects in Sections I, II and III.

Candidates may also be required to have some knowledge of certain well known national head-dresses, such as the caps worn by French, Swiss and Dutch peasant women, and those worn by Nuns and by English University students. It has been further

suggested that the Examination might be such as to include an elementary knowledge of design for embroidery and braiding as applied to garments and of colour arrangement as applied to millinery.

The Examination will be held on **Monday, July 1st**, commencing at 10 a.m., one hour being allowed for a candidate who is presenting herself in any one subject (*Dressmaking or Millinery or Needlework*), and one and a half hours for a candidate taking more than one subject. Where the accommodation at any centre does not suffice to enable all the candidates to be examined simultaneously, the candidates may be arranged in groups, who will take the test at different hours.

The fee for the Examination is *Two Shillings and Sixpence*.

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SCHOLARSHIPS, EXHIBITIONS, AND MONEY PRIZES  
OFFERED BY THE CITY LIVERY COMPANIES  
ON THE RESULTS OF THE EXAMINATIONS  
IN TECHNOLOGY TO BE HELD IN 1912.

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DRAPERS' COMPANY'S EXHIBITIONS AND SCHOLARSHIPS.

In the Spinning and Weaving branches of each of the five Textile Subjects :—

TWENTY EXHIBITIONS of £10 each for two years, and renewable for a third year.

In the Weaving Branch of each of the five Textile Subjects :—

FIVE SCHOLARSHIPS of the value of £60 each, in addition to College Fees for two years, and renewable for a third year.

*For particulars, see p. 107.*

CLOTHWORKERS' COMPANY'S PRIZES.

In Woollen and Worsted Spinning; in each division of Woollen and Worsted Weaving (in each section of the Final Examination); in Cotton Spinning, and in Cotton Weaving (in each section of the Final Examination) :—

FINAL EXAMINATION.

1st Prize	...	...	£3 and Institute's Silver Medal;
2nd "	...	...	£2 10s. and Institute's Silver Medal.

GRADE II.

1st Prize	...	...	£2 10s. and Institute's Bronze Medal;
2nd "	...	...	£2       "       "       Bronze Medal;
3rd "	...	...	£1       "       "       Bronze Medal.

In Linen Weaving (in each section of the Final Examination); and in Jute Weaving (in each section of the Final Examination) :—

FINAL EXAMINATION.

A Prize of £3 and Institute's Silver Medal.

GRADE II.

1st Prize	...	...	£2 and Institute's Bronze Medal;
2nd "	...	...	£1 10s. and Institute's Bronze Medal;
3rd "	...	...	Institute's Bronze Medal.

In Flax Spinning; in Silk Throwing and Spinning; in Silk Weaving; in Jute Spinning; and in Engraving for Calico Printers :—

## FINAL EXAMINATION.

A Prize of £3 and Institute's Silver Medal.

## GRADE I.

1st Prize	...	...	£2 and Institute's Bronze Medal ;
2nd "	...	...	£1 10s. and Institute's Bronze Medal ;
3rd "	...	...	Institute's Bronze Medal.

## GOLDSMITHS' COMPANY'S PRIZES.

In Goldsmiths' Work ; and in Electric Wiremen's Work :—

## FINAL EXAMINATION.

1st Prize	...	...	£3 and Institute's Silver Medal ;
2nd "	...	...	£2 10s. and Institute's Silver Medal.

## GRADE I.

1st Prize	...	...	£2 10s. and Institute's Bronze Medal ;
2nd "	...	...	£2 " " Bronze Medal ;
3rd "	...	...	£1 " " Bronze Medal.

In Electro-Metallurgy ; in Mine Surveying ; and in Pottery and Porcelain :—

## FINAL EXAMINATION.

A Prize of £3 and Institute's Silver Medal.

## GRADE II.

1st Prize	...	...	£2 and Institute's Bronze Medal ;
2nd "	...	...	£1 10s. and Institute's Bronze Medal ;
3rd "	...	...	Institute's Bronze Medal.

In Silversmiths' Work ; in Gas Engineering ; in Gas Supply ; and in Engineers' Quantities :—

## FINAL EXAMINATION.

A Prize of £3 and Institute's Silver Medal.

## GRADE I.

1st Prize	...	...	£2 and Institute's Bronze Medal ;
2nd "	...	...	£1 10s. and Institute's Bronze Medal ;
3rd "	...	...	Institute's Bronze Medal.

In Electrical Engineering :—

## FINAL EXAMINATION.

(In each of the four Sections.)

1st Prize	...	...	£3 and Institute's Silver Medal ;
2nd "	...	...	£2 10s. and Institute's Silver Medal.

## GRADE II.

1st Prize	...	...	£2 10s. and Institute's Bronze Medal ;
2nd "	...	...	£2 and Institute's Bronze Medal ;
3rd "	...	...	£1 10s. and Institute's Bronze Medal ;
4th "	...	...	£1 and Institute's Bronze Medal.

**In Mechanical Engineering :—****FINAL EXAMINATION.****In Machine Designing :—**

- |           |     |     |                                       |
|-----------|-----|-----|---------------------------------------|
| 1st Prize | ... | ... | £3 and Institute's Silver Medal ;     |
| 2nd "     | ... | ... | £2 10s. and Institute's Silver Medal. |

**In each of the three sections of Workshop Practice :—**

A Prize of £3 and Institute's Silver Medal.

**GRADE II.****In Machine Drawing and Designing.**

- |           |     |     |  |
|-----------|-----|-----|--|
| 1st Prize | ... | ... | £2 10s. and Institute's Bronze Medal ; |
| 2nd "     | ... | ... | £2 and Institute's Bronze Medal ;      |
| 3rd "     | ... | ... | £1 " " Bronze Medal.                   |

**In Fitters' Work ; in Pattern Making ; in Foundry Work ; and in Smiths' Work :—**

- |           |     |     |                                   |
|-----------|-----|-----|-----------------------------------|
| 1st Prize | ... | ... | £2 and Institute's Bronze Medal ; |
| 2nd "     | ... | ... | £1 " " Bronze Medal.              |

**MERCHANT TAYLORS' COMPANY'S PRIZES.****In Tailor's Cutting ; in Embroidery ; in Lace Manufacture ; and in Silk Dyeing :—****FINAL EXAMINATION.**

A Prize of £2 and Institute's Silver Medal.

**GRADE I.**

- |           |     |     |  |
|-----------|-----|-----|--|
| 1st Prize | ... | ... | £1 10s. and Institute's Bronze Medal ; |
| 2nd "     | ... | ... | £1 " " Bronze Medal ;                  |
| 3rd "     | ... | ... | Institute's Bronze Medal.              |

**In Dressmaking :—**

- |           |     |     |                                   |
|-----------|-----|-----|-----------------------------------|
| 1st Prize | ... | ... | £3 and Institute's Silver Medal ; |
| 2nd "     | ... | ... | £3 " " Bronze Medal ;             |
| 3rd "     | ... | ... | £2 " " Bronze Medal ;             |
| 4th "     | ... | ... | £1 " " Bronze Medal ;             |
| 5th "     | ... | ... | Institute's Bronze Medal.         |

**In Rail Carriage Building :—****FINAL EXAMINATION.**

- |           |     |     |                                       |
|-----------|-----|-----|---------------------------------------|
| 1st Prize | ... | ... | £3 and Institute's Silver Medal ;     |
| 2nd "     | ... | ... | £2 10s. and Institute's Silver Medal. |

**GRADE I.**

- |           |     |     |  |
|-----------|-----|-----|--|
| 1st Prize | ... | ... | £2 10s. and Institute's Bronze Medal ; |
| 2nd "     | ... | ... | £2 " " Bronze Medal ;                  |
| 3rd "     | ... | ... | £1 " " Bronze Medal.                   |

## SALTERS' COMPANY'S PRIZES.

In Salt Manufacture; in Alkali Manufacture; in Soap Manufacture; in Breadmaking; in Spirit Manufacture; in Coal Tar Distillation; in Coal Tar Colouring Matters; in Sugar Manufacture; in Painter's Oils, Colours, &c.; in Oils and Fats; in each section of Photography; in Cotton Bleaching; and in Calico Printing.

## FINAL EXAMINATION.

A Prize of £2 and Institute's Silver Medal.

## GRADE I.

1st Prize	...	...	£1 10s. and Institute's Bronze Medal;
2nd "	...	...	£1 " " Bronze Medal;
3rd "	...	...	Institute's Bronze Medal.

## CORDWAINERS' COMPANY'S PRIZES.

In Boot and Shoe Manufacture :—

## FINAL EXAMINATION.

1st Prize	...	...	£3 and Institute's Silver Medal;
2nd "	...	...	£2 10s. and Institute's Silver Medal.

## GRADE III.

1st Prize	...	...	£2 10s. and Institute's Bronze Medal;
2nd "	...	...	£2 " " Bronze Medal;
3rd "	...	...	£1 " " Bronze Medal.

In Masonry :—

## FINAL EXAMINATION.

1st Prize	...	...	£3 and Institute's Silver Medal;
2nd "	...	...	£2 10s. and Institute's Silver Medal.

## GRADE I.

1st Prize	...	...	£2 10s. and Institute's Bronze Medal;
2nd "	...	...	£2 " " Bronze Medal;
3rd "	...	...	£1 " " Bronze Medal.

In Lithography :—

## FINAL EXAMINATION.

A Prize of £2 and Institute's Silver Medal.

## GRADE II.

1st Prize	...	...	£1 10s. and Institute's Bronze Medal;
2nd "	...	...	£1 " " Bronze Medal.

In Paper Manufacture :—

## FINAL EXAMINATION.

A Prize of £2 and Institute's Silver Medal.

## GRADE I.

1st Prize	...	...	£1 10s. and Institute's Bronze Medal;
2nd "	...	...	£1 " " Bronze Medal.

## SKINNERS' COMPANY'S PRIZES.

In Builders' Quantities :—

## FINAL EXAMINATION.

1st Prize	...	...	£3 and Institute's Silver Medal ;
2nd "	...	...	£2 10s. and Institute's Silver Medal.

## GRADE I.

1st Prize	...	...	£2 10s. and Institute's Bronze Medal ;
2nd "	...	...	£2 " " Bronze Medal ;
3rd "	...	...	£1 " " Bronze Medal ;
4th "	...	...	Institute's Bronze Medal.

In Bookbinding, in each section (Forwarding and Finishing) ;  
and in Leather Dyeing :—

## FINAL EXAMINATION.

A Prize of £2 and Institute's Silver Medal.

## GRADE I.

1st Prize	...	...	£1 10s. and Institute's Bronze Medal ;
2nd "	...	...	£1 " " Bronze Medal ;
3rd "	...	...	Institute's Bronze Medal.

## PLASTERERS' COMPANY'S PRIZES.

In Plasterers' Work :—

## FINAL EXAMINATION.

1st Prize	...	...	£8 and Institute's Silver Medal ;
2nd "	...	...	£7 " " Silver Medal ;
3rd "	...	...	£5 " " Silver Medal.

## GRADE I.

1st Prize	...	...	£2 10s. and Institute's Bronze Medal ;
2nd "	...	...	£1 10s. " " Bronze Medal ;
3rd "	...	...	£1 " " Bronze Medal.

## CUTLERS' COMPANY'S PRIZES.

In the Occurrence, Raising and Dressing of Ores :—

## FINAL EXAMINATION.

1st Prize	...	...	£3 and Institute's Silver Medal ;
2nd "	...	...	£2 10s. and Institute's Silver Medal.

## GRADE I.

1st Prize	...	...	£2 10s. and Institute's Bronze Medal ;
2nd "	...	...	£1 10s. " " Bronze Medal ;
3rd "	...	...	£1 " " Bronze Medal.

*Livery Companies' Prizes.*

PEWTERERS' COMPANY'S PRIZES.

In Metal Plate Work ; and in Milling :—

FINAL EXAMINATION.

A Prize of £3 and Institute's Silver Medal.

GRADE I.

1st Prize	...	...	£2 10s. and Institute's Bronze Medal ;
2nd "	...	...	£1 10s. " " Bronze Medal ;
3rd "	...	...	Institute's Bronze Medal.

In Telegraphy ; and in Telephony :—

FINAL EXAMINATION.

1st Prize	...	...	£3 and Institute's Silver Medal ;
2nd "	...	...	£2 10s. and Institute's Silver Medal.

GRADE I.

1st Prize	...	...	£2 and Institute's Bronze Medal ;
2nd "	...	...	£1 " " Bronze Medal ;
3rd "	...	...	Institute's Bronze Medal.

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CARPENTERS' COMPANY'S PRIZES.

In Carpentry and Joinery :—

FINAL EXAMINATION.

1st Prize	...	...	£3 and Institute's Silver Medal ;
2nd "	...	...	£2 10s. and Institute's Silver Medal ;
3rd "	...	...	£2 " " Silver Medal.

GRADE II.

1st Prize	...	...	£2 10s. and Institute's Bronze Medal ;
2nd "	...	...	£2 " " Bronze Medal ;
3rd "	...	...	£1 10s. " " Bronze Medal ;
4th "	...	...	£1 " " Bronze Medal ;
5th "	...	...	10s. " " Bronze Medal.

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LEATHERSELLERS' COMPANY'S PRIZES.

In Leather Tanning ; and in Dressing of Skins :—

FINAL EXAMINATION.

1st Prize	...	...	£3 and Institute's Silver Medal ;
2nd "	...	...	£2 10s. and Institute's Silver Medal.

GRADE I.

1st Prize	...	...	£2 10s. and Institute's Bronze Medal ;
2nd "	...	...	£1 10s. " " Bronze Medal ;
3rd "	...	...	£1 " " Bronze Medal.



## DYERS' COMPANY'S PRIZES.

In Wool Dyeing ; and in Cotton Dyeing :—

## FINAL EXAMINATION.

A Prize of £3 and Institute's Silver Medal.

## GRADE I.

1st Prize	...	...	£2 10s. and Institute's Bronze Medal ;
2nd "	...	...	£1 10s. " " Bronze Medal ;
3rd "	...	...	10s. " " Bronze Medal.

---

## IRONMONGERS' COMPANY'S PRIZES.

In Iron and Steel Manufacture :—

## FINAL EXAMINATION.

1st Prize	...	...	£3 and Institute's Silver Medal ;
2nd "	...	...	£2 10s. and Institute's Silver Medal.

## GRADE II.

1st Prize	...	...	£2 10s. and Institute's Bronze Medal ;
2nd "	...	...	£1 10s. " " Bronze Medal ;
3rd "	...	...	£1 " " Bronze Medal.

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## FRAMEWORK KNITTERS' COMPANY'S PRIZES.

In Framework Knitting :—

## FINAL EXAMINATION.

A Prize of £2 and Institute's Silver Medal.

## GRADE I.

1st Prize	...	...	£2 and Institute's Bronze Medal ;
2nd "	...	...	£1 " " Bronze Medal ;
3rd "	...	...	Institute's Bronze Medal.

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## CLOCKMAKERS' COMPANY'S PRIZES.

In Watch and Clock Making :—

## FINAL EXAMINATION.

1st Prize	...	...	£3 and Institute's Silver Medal ;
2nd "	...	...	£2 10s. and Institute's Silver Medal.

## GRADE I.

1st Prize	...	...	£2 10s. and Institute's Bronze Medal ;
2nd "	...	...	£1 10s. " " Bronze Medal ;
3rd "	...	...	£1 " " Bronze Medal ;

*Livery Companies' Prizes.*

COACH MAKERS' AND COACH HARNESS MAKERS'  
COMPANY'S PRIZES.

In Road Carriage Building including Motor Car Body Work :—

FINAL EXAMINATION.

1st Prize	...	...	£3 and Institute's Silver Medal ;
2nd "	...	...	£2 10s. and Institute's Silver Medal.

GRADE I.

1st Prize	...	...	£2 10s. and Institute's Bronze Medal ;
2nd "	...	...	£2 " " Bronze Medal ;
3rd "	...	...	£1 " " Bronze Medal.

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TYLERS' AND BRICKLAYERS' COMPANY'S PRIZES.

In Brickwork :—

FINAL EXAMINATION.

1st Prize	...	...	£3 and Institute's Silver Medal ;
2nd "	...	...	£2 10s. and Institute's Silver Medal.

GRADE I.

1st Prize	...	...	£2 10s. and Institute's Bronze Medal ;
2nd "	...	...	£1 10s. " " Bronze Medal ;
3rd "	...	...	£1 " " Bronze Medal.

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BASKET MAKERS' COMPANY'S PRIZES.

In Basket Work :—

FINAL EXAMINATION.

1st Prize	...	...	£3 and Institute's Silver Medal ;
2nd "	...	...	£2 10s. and Institute's Silver Medal.

GRADE I.

1st Prize	...	...	£2 10s. and Institute's Bronze Medal ;
2nd "	...	...	£2 " " Bronze Medal ;
3rd "	...	...	£1 " " Bronze Medal.

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WHEELWRIGHTS' COMPANY'S PRIZES.

In Wheelwrights' Work and Van and Cart Building :—

FINAL EXAMINATION.

A Prize of £2 and Institute's Silver Medal.

GRADE I.

1st Prize	...	...	£2 and Institute's Bronze Medal ;
2nd "	...	...	£1 " " Bronze Medal ;
3rd "	...	...	Institute's Bronze Medal.

## FOUNDERS' COMPANY'S PRIZES.

## In Motor Car Engineering :—

## FINAL EXAMINATION.

A Prize of £3 and Institute's Silver Medal.

## GRADE II.

1st Prize	...	...	£2 and Institute's Bronze Medal ;
2nd "	...	...	£1 " " Bronze Medal ;
3rd "	...	...	Institute's Bronze Medal.

## In Boiler Makers' Work :—

## FINAL EXAMINATION.

A Prize of £3 and Institute's Silver Medal.

## GRADE I.

1st Prize	...	...	£2 and Institute's Bronze Medal ;
2nd "	...	...	£1 " " Bronze Medal ;
3rd "	...	...	Institute's Bronze Medal.

## NEEDLEMAKERS' COMPANY'S PRIZES.

## In Plain Needlework ; and in Millinery :—

1st Prize	...	...	£2 and Institute's Silver Medal ;
2nd "	...	...	£2 " " Bronze Medal ;
3rd "	...	...	£1 " " Bronze Medal ;
4th "	...	...	Institute's Bronze Medal.

## STATIONERS' COMPANY'S PRIZES.

Particulars of the special prizes offered by the Company in the subjects of Typography, Lithography and Bookbinding will be found under the syllabuses of these subjects (see pp. 212, 217, 265).

Money Prizes will be given by the Institute in the following subjects not included in the above List :—

Brewing, £6; Glass Manufacture, £4; Plumbers' Work, £15; Typography, £11; Slate Quarrying, £4; Painters' and Decorators' Work, £11; Cabinet Making, £7.

Silver Medals are offered by the Institute on the results of the Final Examination, and Bronze Medals on the results of the examination in the Grade next below the Final, in all Technological Subjects.

For exhibitions, prizes, &c., offered by other bodies, see under syllabuses of subjects in connection with which the offers are made.

# LIST OF PERSONS REGISTERED AS QUALIFIED TEACHERS IN TECHNOLOGY.

*(Revised to March 31st, 1911.)*

Teachers who desire their names to be retained on this List should send not later than January 31st, 1912, their present addresses to the Office of the Department of Technology, City and Guilds of London Institute, Exhibition Road, London, S.W.

*Notice should be given of any change of address.*

The letter *c* after a name signifies teacher of a "registered class" during the session 1910-11.

## Alkali Manufacture.

DIXON, A. C., M.A.,		
B.Sc.	...	Darlington
GRANT, J.	...	Manchester
HALL, R. J.	...	Liscard
HEYWOOD, J. H., F.C.S.	...	Rochdale
HUNTER, F. W.	...	Durham
TYERS, C. E.	...	Widnes
WAKEFIELD, W. C.	...	Dewsbury

## Basket Making.

BULLARD, C. H.	...	Royston
CHEEK, J.	...	c London
DEIGHTON, S.	...	c Manchester
FREEMANTLE, G.	...	Guildford
PACKMAN, D.	...	St. Paul's Cray
THIXTON, H.	...	Melbourn, Cambs.

## Boilermakers' Work.

AUSTIN, W.	...	Stockton-on-Tees
BAXTER, J. H.	...	Old Trafford
BRAIN, H. R.	...	West Ham
GREENSLADE, G. T.	c	London
HAM, S.	...	Belfast
HANDY, C. E.	...	Portsmouth
HINTON, A. G., B.Sc.	...	London

HONIBALL, E. R.	...	Liverpool
HUNTER, C. F.	...	Sunderland
IRVING, W.	...	Sheffield
KILSHAW, T. E.	...	Swindon
REYNOLDS, E. W.	c	Portsmouth
ROGERS, A. J.	...	London
SCORER, N.	...	c Wallsend-on-Tyne
SMITH, V.	...	London
SPROSON, R. J.	c	Crewe
WILKINSON, G. R.	c	Northwich

## Bookbinding.

BARKER, A.	...	Leeds
BATES, J. S. H.	c	Leicester
CURRIE, A.	c	Edinburgh
DIBBENS, J. W.	...	Bushey
ELSTON, W. J.	c	Liverpool
GARRETT, F.	c	Birmingham
GILLETT, W. A.	c	Bristol
HAINES, J.	...	c Liverpool
HOLDER, C. H. C.	c	Leeds
LUCKING, B. A. (Miss)	c	Acton
MAULLEN, F.	c	London
MELLOR, W.	c	Manchester
MELLOR, W., Jr.	c	Manchester
MENZIES, W. M.	c	Manchester
PARROTT, T. S.	c	Dorking
PHILPOT, T. R. (Miss)	c	Cambridge

SANGORSKI, F.	c	London
SAUNDERS, F. L.	...	Tunbridge Wells
SPINK, W.	c	Leeds
THOMPSON, D. J.	c	Edinburgh
WEEDON, S.	c	London
WITTED, T.	...	London

### Boot and Shoe Manufacture.

BEDFORD, W. J.	...	London
BRANCH, C. H.	c	London
BROOKES, R. H.	c	Leicester
CARTER, H. A.	...	Bristol
CATLING, E.	...	Kettering
COOPER, W. W.	...	Cork
FINLOW, O. J.	...	Stafford
HALLIDAY, A.	...	Derby
HARDING, J. S.	c	Leeds
HARRIS, F.	c	Nantwich
HARVEY, C.	...	Woking
HILL, H.	...	London
HODGES, A. F.	...	Street
HOOPER, F. G.	...	Leeds
JOYCE, F.	...	Leicester
KNIGHT, F.	...	Leicester
LANT, J. E.	...	Leicester
LEONARD, E.	c	Dublin
LEWIS, W. J.	...	Northampton
LONDON, H. R.	...	Bristol
NEVE, A. F.	c	Norwich
PEARCE, T.	...	Feltham
PLUCKNETT, F.	c	Leicester
POWLEY, A. E.	c	Wolverhampton
ROBERTS, C. F.	c	Leicester
ROBINS, L.	...	Belfast
STANGER, W.	...	Leicester
SWAYSLAND, E.	...	Northampton
WHEATLEY, J. G.	...	Dublin

### Breadmaking.

ARMITSTEAD, J.	...	Leeds
BROOKS, E.	...	Bradford
COOK, E. H.	...	Bristol
DAVIES, J.	c	Liverpool
GALE, H. J.	...	Bristol
KIRKLAND, J.	c	London
LONGNEY, T. W.	...	Bristol
MAKIN, C. W.	c	Chorley
MEIKLE, J.	c	Belfast
QUINN, W. H.	c	Leeds
ROTTERS, J. H.	c	Hull
RUSSELL, W.	c	Birmingham
SMITH, J. K.	...	Leith
WALKER, O. H. H.	...	Whitehaven

### Brewing.

CHEATER, T. J.	...	London
COOK, E. H.	...	Bristol
GRANT, J.	c	Manchester
HUNTER, J.	...	Edinburgh
LING, A. R.	c	London
PRICE, A., B.Sc.	...	Wakefield
RICHARDS, F. G.	c	Manchester
WESTERGAARD, E.	c	Edinburgh

### Brickwork.

ADAM, H. M.	...	Jarrow
ALLIBONE, G.	...	Oxford
ARNALL, G.	c	London
BARRETT, C. W.	...	London
BATES, E. L.	...	London
BURNS, D.	...	Pollokshaws
BUSBRIDGE, H., A.R.I.B.A.	...	London
CARR, R.	c	Hyde
CHARLESWORTH, R.	c	Sheffield
CLIPSHAM, R.	...	London
CORBEN, F.	...	London
DEAKIN, W.	...	Manchester
DIXON, W. M.	...	London
DUNN, J. G.	c	Glasgow
EVANS, S.	...	Croydon
FISHER, R.	...	Tottenham
FITZGERALD, J.	...	London
FLAHERTY, W.	c	London
GOURLAY, C., B.Sc., A.R.I.B.A.	...	Glasgow
GRAY, D.	...	Lochee
GRUBB, H. C.	...	Bromley
HODGSON, H., A.R.I.B.A.	c	Bradford
HOLMES, B.	...	Keighley
JESSIMAN, J.	...	Elgin
JONES, A.	...	Leeds
JONES, D. P.	...	Llandaff
KIRK, J. W.	...	London
LAWSON, A. C.	c	Manchester
LIDDELL, R. W.	...	North Shields
LYONS, P.	c	Newcastle-on-Tyne
MADDERN, H.	...	Penzance
MARRIOTT, J. W.	...	Chester
MARSDEN, R. E.	c	London
MARTIN, T.	...	Coatbridge
MASTERS, W. H.	...	Southampton
MITCHELL, G. A.	...	London
NARIE, J.	...	Glasgow
NEIL, W. W.	...	London
NEWMAN, A. H.	c	London
NOAKES, G. T.	c	London
OLDERSHAW, S. B.	...	Lincoln
PHILLIPS, H.	...	Norwich
PIDGEON, W. E.	...	Bristol
PLATT, F. W.	...	Manchester
PYE, F. J.	c	Preston
QUINN, E.	...	Hull

READ, J. W....	...	London
SMITH, H. ...	c	London
SMITH, T. ...	...	Walthamstow
STOTT, J. ...	...	Leigh
STOTT, JULIUS	...	Newton Heath
TAYLOR, F. R.	...	London
WARRINGTON, J.	c	Leeds
WHEWELL, M.	c	Blackburn
WHINCUP, W. T.	c	York
WHITEHEAD, R. D.	c	Derby
WILDING, J. ...	c	Liverpool
WORTHINGTON, E....	...	Peterborough

## Builders' Quantities.

ALLEN, S. E.	...	Kew
ALLIBONE, G.	...	Oxford
ALLISON, G. H.	c	Grimsby
ANDERSON, W. F.	...	Bury
ARMSTRONG, A. L.	...	Harrogate
ASSITER, H. G.	...	London
BALLARD, W. E.	c	Birmingham
BALLARD, W. J.	...	Birmingham
BARNES, A. ...	c	Brighton
BARNES, F. J.	c	Bristol
BAYLIS, A. E.	...	London
BENDING, F. B.	c	Tunbridge Wells
BENNION, A. S.	...	Ipswich
BIRCH, P. E.	...	Whitkirk
BRACEWELL, A.	c	Keighley
BRIGGS, A. ...	c	Manchester
BROAD, F. J....	c	Bournemouth
BROWN, E. F.	...	London
BURT, J. T. ...	...	Loughborough
BUTTERY, W.	c	Morley
CASTELL, W. T. W.	c	London
CHADWICK, A. S.	c	Rochdale
COULSON, R. ...	c	Dublin
COWLEY, H. R.	c	Southend-on-Sea
CRABB, H. R.	...	Birmingham
CRESSWELL, W. T.	c	London
CREWDSON, J.	c	S. Norwood
CROSS, A. G., F.S.I.	c	Hackney
DADD, C. J. ...	...	London
DAVIDSON, W. J.	c	Liverpool
DAVIES, S. ...	...	Liscard
DOUGLAS, J. W.	c	Newcastle-on-Tyne
FISHER, R. ...	c	Tottenham
FLETCHER, R. H.	c	Hull
FREEMAN, R. L.	c	London
FRY, J. H. F.S.I.	c	London
GAMBLE, J. G.	...	Belfast
GHEST, S. J. ...	c	Darlington
GLEED, P. F.	c	London
GRAY, J. V. ...	c	Dartford
GRUBB, H. C.	...	Bromley
HAMMICK, H. J.	c	Devonport
HARRIS, S. F., F.R.I.B.A.	c	Northampton
HEWITT, F. ...	c	Manchester
HILL, A. ...	c	Huddersfield
HODGSON, H., A.R.I.B.A.	...	Bradford
HOLMES, H. H.	c	London
HUTT, H., A.R.I.B.A.	c	Reading
JOHNSON, A.	...	Wilmslow
KIRK, J. W., F.S.I.	...	London
LAMBLE, W. H.	c	Wigan
LEE, W. W. ...	c	Shildon
LICKS, L. ...	c	London
LUOK, D. L. ...	c	Folkestone
MANSON, J. L.	c	Leicester
MAYELL, A. Y.	...	London
MERREDEW, G. E.	c	Acton
MILL, R. A. ...	c	Plymouth
MITCHELL, C. F.	c	London
MITCHELL, G. A.	c	London
MORRIS, P. A.	c	St. Helens
MURPHY, J. ...	c	Cork
NIXBY, F. S. ...	c	Oxford
OAKY, J. J. L.	c	Cheltenham
PASCOE, H. ...	...	Leeds
POWER, J., B.A.	...	London
PRIESTLEY, J.	c	Leeds
PYE, F. J. ...	c	Preston
PYLE, B. T. R.	...	Tottenham
RACE, W. L. ...	...	Bishop Auckland
RAE, T. H. ...	c	Sunderland
RAINBOW, P. L.	c	Coventry
RANSOM, W. ...	...	Worcester
READ, K. H. ...	c	Stroud
REDMOND, T.	c	Limerick
SCAIFE, E. J.	c	Bolton
SMITH, G. ...	c	Norwich
SMITH, R. H.	...	Bristol
STAFFORD, C. E.	c	Derby
STAINES, C. J.	c	Bath
SWAN, J. H. ...	...	London
TAYLOR, J. J.	c	London
THOMPSON, C. E.	...	Grimsby
TOLLIT, R. J.	c	Cambridge
TUTTE, A. E.	c	Portsmouth
VEALE, L. C. ...	c	London
WARREN, H. G., A.R.I.B.A.	...	Eltham Park
WOODLEY, W.	c	Richmond
WRIGHT, H. A.	c	London
WYLIE, R. ...	c	Durham

## Cabinet Making.

BRIEN, C. C. ...	c	Liverpool
CARR, A. ...	c	London
COX, W. ...	...	London
DUNKIN, J. ...	c	London
FAIRHAM, W.	...	Leicester
FREEMAN, C.	...	London
HAWKING, E.	...	London
HICKS, J. ...	c	Dublin
HOOPER, J. ...	c	London
KERSHAW, J.	...	Wigan
JEFFERSON, J. W.	...	Belfast
KIDD, J. A. ...	...	Dundee
MACE, T. H. ...	...	North Walsham

MARTIN, H. J. S.	c	London
MCLEOD, W.	...	Aberdeen
MORGAN, H. T. J.	c	London
O'FLAHERTY, J. J.	...	Athlone
RICHTER, C. A.	...	Bath
RICHTER, H. D.	...	Bath
RICKARD, C. R.	c	London
ROBINSON, R.	c	Belfast
ROE, J. G.	...	Norwich
ROWBOTHAM, J. W.	c	London
RUDD, J. H.	c	Barnstaple
SMERDON, R.	c	London
SMITH, G. H.	c	Leeds
SPOONER, C.	...	London
STILLWELL, S. H.	c	London
TANNER, W. A.	...	Bath
TURNER, H.	...	Scarborough
VENNELLE, A. S.	...	Gosport
WELLS, P. A.	c	London
WILKINS, J. B.	c	Lancaster

## Calico and Linen Printing.

APPLEYARD, J. R.	...	Salford
F.C.S.	c	Salford
BRIGGS, R. H.	...	Bury
BUTTERWORTH, G. F.	...	Radcliffe
CLAYTON, E.	c	Belfast
DAVIES, C. B.	...	Radcliffe
EWING, A.	...	Ramsbottom
GADD, W. L., F.I.C.	...	Gloucester
HANDLEY, B.	...	Oswaldtwistle
HOLDEN, G. E.	...	Middleton
HÜBNER, J., M.Sc.	c	Manchester
JACKSON, Wm. B.	...	Glasgow
KNECHT, E., Ph.D.	...	Manchester
F.I.C.	c	Manchester
MARSHALL, W.	...	Manchester
NICHOLS, J. A.	...	New Mills
PARKES, G. A.	...	Belfast
ROBERTS, H. D.	...	Rochdale
ROSTRON, H., B.Sc.	...	Bolton
F.C.S.	...	Bolton
TURNER, A.	...	New Mills

## Carpentry and Joinery.

ADAM, H. M.	c	Durham
ALLIBONE, G.	c	Oxford
AMBROSE, W.	...	Twickenham
ANDERSON, J.	c	Liscard
ANDERSON, W. F.	c	Altrincham
ARMSTRONG, H. O.	c	Tralee
ARNALL, G.	...	London
ASHBY, W.	...	Barry
ASHCROFT, T.	...	Galway
ASHTON, S.	...	Oldham
ATKINSON, J. P.	...	Portadown
AYRES, G.	...	Kilburn
BARKER, G. H.	...	Wellingborough

BARNES, H. T.	c	London
BARR, C. N.	...	Colne
BARSBY, H.	...	London
BEALE, S. H.	...	Banbury
BEECHAM, A. C.	c	London
BELL, A.	...	Camborne
BERTWISTLE, J. A.	c	Preston
BETAMBEAU, W. H.	...	London
BIRRELL, W.	...	Leicester
BLAIR, W. S.	c	Waterford
BLAKE, A. W.	c	Bath
BOLTON, H.	...	Wimbledon
BOXALL, C. W. D.	...	Sheffield
BRAYBROOKS, T. P.	c	Norwich
BRENNER, T.	c	Southend
BREWSTER, E.	c	Woolwich
BROOKS, F.	...	Croydon
BROOKS, S.	...	Radcliffe
BROOMAN, B. W.	...	Tunbridge Wells
BROWN, D.	...	Clonmel
BROWN, W. O.	...	St. Helens
BUCKLEY, J.	...	Dewsbury
BULL, T.	...	Rotherham
BURKE, P.	...	Dundalk
BURNS, D.	...	Pollokshaws
BURTON, T.	...	West Hartlepool
BUSBRIDGE, H.	...	Plumstead
A.R.I.B.A.	...	Leeds
BUSH, F.	c	Leeds
CAMM, G. F.	...	Manchester
CANTELL, M. T.	c	Brighton
CARMICHAEL, J. N.	...	Aberdeen
CARR, R.	...	Hyde
CARTER, A.	...	Thornton Heath
CHAMBERS, C. P.	...	Broughton-in-Furness
CHAPPELL, C. H.	...	Belfast
CHRISTIE, P.	...	Alloa
CLAPHAM, H.	c	Smethwick
CLARK, G. H.	c	Carshalton
CLARK, J.	...	Tunbridge Wells
CLARKE, F.	c	Wellingborough
CLARKE, F.	c	Huddersfield
CLAYDON, E. G.	...	Bolton
CLAYDON, G. T.	...	London
CLAYTON, J.	...	Macclesfield
CLUTTERBUCK, W. G.	...	Woodford, Essex
COLBURN, J.	...	Sheffield
COOPER, R. C. O.	c	Bournemouth
CORBEN, F.	...	London
COULDWELL, H. C.	c	Hull
COX, W.	c	London
CRANDELL, F.	...	Brighton
CRESSWELL, F. O.	c	Liverpool
CREWDSON, J.	...	S. Norwood
CRUTCHSHANK, A.	c	Aberdeen
CUNNINGSON, G.	...	Blairgowrie
DALTON, P. J.	...	Clonmel
DANIELL, J. B.	...	London
DAVEY, H. A.	c	London
DAVIDSON, W.	c	Belfast
DAVIS, J.	...	London

DAVISON, J. E.	c	Burnley	HERRIN, J.	...	London
DAY, A. G.	...	Bath	HEWITT, E.	...	Bradford
DENNY, C. W.	c	Wimbledon	HEY, H.	...	Surbiton
DERMOTT, A. T.	c	Hastings	HICKS, G. F.	...	Brentford
DEWAR, D.	...	Rothsay	HILL, C. S.	...	Pontycymmer
DIXON, J. H.	...	Manchester	HINCHCLIFFE, F. R.	...	Marple Bridge
DIXON, W. M.	...	London	HINCHCLIFFE, W.	c	Hove
DONALDSON, A.	...	Widnes	HODGSON, H.,		
DOWSETT, J. F.	c	London	A.R.I.B.A.		Bradford
DRAKE, F.	...	Hounslow	HODGSON, R. W.	...	London
DRINKWATER, F. W.	c	Plymouth	HOLDEN, E.	...	Newry
DRURY, F. E.	c	Halifax	HOLLINGWORTH, W.	c	Nottingham
DUNLOP, J. Y.	...	Paisley	HOLMES, B.	...	Keighley
EDWARDS, T. A.	c	London	HOLT, J. H.	...	Bolton
ELLIS, G.	...	London	HOOLEY, J.	...	Macclesfield
ELLISON, W.	...	Perth	HUNT, H. T.	...	Maidstone
EVANS, S.	...	Croydon	HURLEY, T. J.	...	Tallamore
FAUX, J.	...	Kingston-on-Thames	HUTCHINGS, J. W.	...	Plymouth
FERRY, F. W.	...	Walthamstow	JACKSON, F.	...	Manchester
FIGGURES, G.	c	Thornton Heath	JACKSON, J.	...	St Annes-on-the-Sea
FILLINGHAM, F.	...	Bristol	JACKSON, J. E. S.	...	St Albans
FINCH, J.	...	London	JAMISON, W. B.	...	Carrickfergus
FISHER, S.	...	Barrow-in-Furness	JAY, J. H. A.	c	Brighton
FLEMING, A. J.	...	Fintry	JESSIMAN, J.	...	Elgin
FORSTER, F.	...	Scarborough	JOHN, J.	...	Cardiff
FOX, H. A.	...	Birmingham	JOHNSON, J.	...	Bury
FREEMAN, R. C.	c	London	JONES, A.	...	Leeds
GARDINER, F.	...	Keswick	JONES, A. H.	...	Woking
GARDNER, H.	...	Middleton	JONES, E.	...	Stoke-on-Trent
GARNER, F.	c	Barnsley	JOSLIN, W. F.	c	Plymouth
GATES, W. S.	...	London	KELLEHER, D. J.	...	Fermoy
GENTLE, O.	...	Watford	KIDD, A.	...	Wallsend-on-Tyne
GEORGE, A.	c	St. Helens	KINNS, H. E.	c	Altrincham
GEORGE, D.	...	London	KITCHING, T. E.	c	Harrogate
GIBB, J. S.	...	Kilkenny	LANIGAN, J.	...	Dungarvan
GIRLING, F. J.	...	Barnsley	LARGE, F. A.	...	Camberley
GOLDTHORP, J. S.	...	Halifax	LAWRANCE, J.	...	Harlesden
GOODSIR, P.	...	Manchester	LAWSON, A. C.	...	Manchester
GOODYEAR, F.	...	Southampton	LAWSON, H. A.	...	Dundalk
GOURLAY, C., B.Sc.,			LEAVER, E.	...	Chorley
A.R.I.B.A.	...	Glasgow	LEEKS, F.	...	Haslemere
GRAY, D.	...	Lochee	LEFLEY, H.	...	Salford
GREAVES, J. E. E.	...	Rochdale	LEIGH, W.	...	Grimsby
GREENHALGH, R.	c	Todmorden	LENNON, J. J.	c	Youghal
GRIMWOOD, A.	c	London	LUNGLEY, T.	...	Kilkenny
GRUBB, H. C.	...	Bromley	MAGNAIR, J. D.	...	London
GYMER, A.	c	London	MADDERN, H.	...	Penzance
HACKING, J.	c	Darwen	MALCOLM, G.	...	Broughty Ferry
HALL, J. T.	...	London	MANNERS, J. D.	c	London
HALMAN, S. E.	c	Coventry	MANSON, J. L.	c	Leicester
HALSALL, J. R.	c	Ballymena	MARGETTS, S. D.	...	Gloucester
HAMMERTON, W. H.	c	Barnsley	MARRIOTT, J. W.	c	Chester
HAMPSHIRE, T. R.	c	London	MARSDEN, R. E.	c	London
HANBY, G. A.	...	Barnsley	MARSHALL, J. E.	c	Warrington
HANCOCK, C. H.	c	London	MARTIN, E. W. F.	...	Tunbridge Wells
HANCOCK, W. E.	...	Hove	MARTIN, T.	...	Coatbridge
HARDINGHAM, E. G.	...	Leamington	MASON, B. F.	...	Wollaston
HART, C.	...	Leith	MASTERS, W. H.	...	Southampton
HARVEY, W.	c	Mortlake	MAY, W. D.	...	Londonderry
HARWOOD, T.	c	Bath	McCORMODALE,		
HAY, T.	...	Edinburgh	G. M.	...	Bushey
			MCCURDY, J. H.	c	West Ham



McLYNN, T....	c	Ballinasloe
MCSWAN, A....	...	Hamilton
MELSON, H. H.	...	London
MERCHANT, F.	c	Salford
MILL, R. A. ...	...	Plymouth
MITCHELL, C. F.	c	London
MITCHELL, G. A.	c	London
MITCHELL, R. A.	c	Belfast
MOLD, W. ...	...	Poole
MOORE, B. ...	...	Keighley
MOORE, F. W.	c	Wigan
MOORE, H. C.	...	Devonport
MOORE, R. ...	c	Ballymoney
MORGAN, F. ...	...	Coventry
MOTTRAM, J.	c	Worcester
MOWAT, W. ...	...	Barrow-in-Furness
MULCAHY, D. A.	...	Tullamore
NELSON, E. P.	c	Dalton-in-Furness
NEWBURN, J. K.	c	Widnes
NEWTON, F. ...	...	Hebden Bridge
NORTON, A. ...	c	London
OAKLEY, J. J. L.	c	Cheltenham
O'CALLAGHAN, J.	...	Dublin
OLDERSHAW, S. B.	c	Lincoln
O'REILLY, P.	...	Dublin
ORMISTON, G. B.	...	Stafford
OTTER, W. ...	...	Luton
OVEREND, C. H.	...	Eccleshill
OVEREND, J. W.	...	Fulneck
PARKER, G. H.	c	London
PARNELL, H.	...	Uxbridge
PARTRIDGE, H.	...	London
PEARCE, J. E.	c	Bristol
PHILLIPS, H.	...	Norwich
PILGRIM, T. ...	...	Edmonton
PRIDMORE, J. T.	c	London
PRINGLE, A. ...	...	Harrow
PROSSER, H. J.	...	London
PRYDE, T. M.	c	Dundee
PYE, F. J. ...	c	Preston
REDMOND, J. J.	c	Kingstown
REDMOND, T.	c	Limerick
REDMOND, W. H.	...	Galway
RICHARDSON, G.	...	Nottingham
RIDSDALE, G. W.	c	Lancaster
RILEY, J. W.	c	Rochdale
RIMINGTON, E.	...	Hull
ROBERTS, D. ...	...	Hamilton
ROBERTS, L. P.	...	Dorking
ROBERTSON, S.	...	London
ROBSON, H. L.	c	Derby
SAISE, A. J. ...	...	Bristol
SALTHOUSE, W.	c	Birkdale
SANDER, H. B. H.	...	Warrington
SANDHAM, J.	c	London
SANDHAM, R.	c	Fleetwood
SCHRÖDER, W. G.	...	Chester
SCHOFIELD, A. E.	...	Wigan
SCOTT, W. A.	c	Portsmouth
SELKIRK, N. ...	c	Dunfermline
SHARPE, S. ...	c	Bingley
SHAW, F. ...	...	Southport

SHERBURN, A.	c	East Ham
SMART, J. ...	...	Aberdeen
SMITH, G. H.	c	Sligo
SMITH, H. ...	...	London
SPARGO, S. J.	c	Bacup
SPENCE, T. ...	c	Hull
SPRING, F. W.	c	Exeter
STANLEY, C. T.	...	London
STEELE, D. W.	...	Wigan
STONE, W. J.	c	Bootle
STOTT, JOHN	...	Leigh
STOTT, JULIUS	...	Newton Heath
STRACHAN, G. R.	c	Aberdeen
STRANGE, E. J.	...	Tunbridge Wells
STUART, J. ...	...	Buckhaven, Fife
TASKER, H. H.	...	London
TAYLOR, S. W.	c	Peterborough
TAYLOR, W. E.	...	Canterbury
THOMAS, J. L.	c	Leicester
THOMAS, W.	...	Keighley
THOMPSON, G.	...	Queenstown
THORNTON, H.	...	Shipley
TOMKINS, A.	c	South Shields
TOMLINSON, F. W.	c	Salford
TRAINOR, R. ...	c	Manchester
TRELAVERN, J. T.	...	London
TRESIDDER, W. H.	...	Falmouth
TRIBE, A. P. ...	...	Putney
TROUNCE, C. H.	...	East Stonehouse
TULLEY, G. W.	c	Leith
TURNER, J. R.	...	Barnsley
WAKE, R. ...	...	Wicklow
WALKER, W.	...	Carshalton
WARREN, J. S.	...	Devonport
WARWICK, W. A.	c	Birkenhead
WEBSTER, G.	c	Luton
WEIR, E. ...	c	Chatham
WHEELER, W. J.	c	Godalming
WHEWELL, M.	c	Blackburn
WHILLIER, A.	...	London
WHINCUP, W. T.	c	York
WHITEHEAD, R. D.	...	Derby
WHITELEY, J.	c	Rochdale
WILLIAMS, H. C.	...	Barry
WILLIAMS, R.	c	Leigh
WILLIAMS, W. R.	c	Newport, Mon.
WILLINGTON, H. S.	c	Wolverhampton
WILSON, A. ...	...	Salford
WILSON, J. T.	c	Northampton
WINTERSGILL, W.	c	London
WISEMAN, A. J.	...	London
WOOD, G. ...	...	Morley
WOODLEY, W.	...	Richmond
WOODHOUSE, R.	...	London
YEATS, J. H.	...	Enfield

## Coal Tar Distillation and Products.

APPLEYARD, J. R.	...	...
F.C.S.	...	Salford

COPE, F. ... ..	Dewsbury
DUNSTAN, A. E., B.Sc.	East Ham
FORT, M. ... ..	Keighley
HALL, R. J. ... ..	Liscard
HEWITT, J. T., M.A., D.Sc. ... ..	London
HEYWOOD, J. H., F.C.S.	Rochdale
KNECHT, E., Ph.D., F.I.C. ... ..	c Manchester
LODGE, E. ... ..	c Huddersfield
MARSHALL, W. ... ..	c Manchester
NICHOLS, J. A. ... ..	New Mills
PARKES, G. A. ... ..	Belfast

## Confectionery.

DAVIES, J. ... ..	c Liverpool
LEE, H. W. ... ..	c London
POWELL, W. ... ..	c Manchester
QUINN, W. H. ... ..	c Leeds
ROTHERS, J. H. ... ..	c Hull

## Cotton and Linen Bleaching.

APPLEYARD, J. R., F.C.S. ... ..	c Salford
ASHWORTH, A. ... ..	Middleton
BAKER, A. ... ..	Darwen
BRIGGS, R. H. ... ..	c Bury
BUTTERWORTH, G. F.	Radcliffe
CLAYTON, E. ... ..	c Belfast
DAVIES, C. B. ... ..	c Radcliffe
EWING, A. ... ..	Ramsbottom
GADD, W. L., F.I.C. ...	Gloucester
HANDLEY, B. ... ..	Oswaldtwistle
HOLDEN, G. E. ... ..	Middleton
HÜBNER, J., M.Sc. ...	c Manchester
JACKSON, W. B. ... ..	Glasgow
KNECHT, E., Ph.D., F.I.C. ... ..	c Manchester
LEDWIDGE, J. G. ... ..	c Drogheda
MARSHALL, W. ... ..	c Manchester
MASON, J. B. ... ..	Dundee
NICHOLS, J. A. ... ..	New Mills
PARKES, G. A. ... ..	Belfast
RAY, W. ... ..	c Manchester
ROBERTS, H. D. ... ..	Rochdale
ROSTRON, H., B.Sc., F.C.S. ... ..	c Bolton
WHITESIDE, J. L. ... ..	c Bolton
YATES, G. T. ... ..	c Paisley

## Cotton Dyeing.

(See below under Dyeing.)

## Cotton Spinning.

AIKMAN, J. ... ..	c Paisley
AINLEY, A. ... ..	Lockwood

ALLETSON, I. ... ..	Oldham
BADLEY, J. ... ..	Failsworth
BAILEY, W. ... ..	c Ashton-under-Lyne
BARBER, F. ... ..	c Ashton-under-Lyne
BARNSEAW, C. ... ..	Stockport
BARON, A. E. ... ..	Bacup
BARRETT, E. ... ..	Rochdale
BELL, A. E. ... ..	c Mossley
BENNETT, A. ... ..	Swinton
BERRY, J. ... ..	c Bolton
BILLINGTON, R. ... ..	c Preston
BOOTH, F. ... ..	Atherton
BOOTH, R. ... ..	c Manchester
BOOTHROYD, J. ... ..	c Farnworth
BRADBURY, F. ... ..	Belfast
BRANSON, W. ... ..	Stockport
BROMLEY, A. ... ..	Hollinwood
BROOKS, C. P. ... ..	Blackburn
BUCKLEY, E. H. ... ..	Stalybridge
BUTTERWORTH, G. ...	Ashton-under-Lyne
CAYANAGH, J. ... ..	Rochdale
CHADWICK, F. ... ..	Rochdale
CHAPPELL, J. ... ..	Reddish
CLEGG, JOHN H. ... ..	Hebden Bridge
CLEGG, JOSEPH H. ...	Milnrow
COOKE, J. ... ..	Oldham
COUSINS, E. ... ..	c Leigh
COWBURN, T. ... ..	c Leigh
CRABTREE, A. ... ..	Todmorden
CRANKSHAW, W. P. ...	c Salford
CRAWSHAW, H. ... ..	Halifax
CRAWSHAW, J. E. ...	Halifax
CROZIER, F. B. ... ..	Walton-le-Dale
DRIVER, S. J. ... ..	c Manchester
DYSON, W. ... ..	Ashton-under-Lyne
EVANS, W. ... ..	New Mills
FITTON, W. ... ..	Shaw
FORRESTER, W. ... ..	c Pendleton
FOX, T. W. ... ..	c Manchester
GARSDALE, E. ... ..	Middleton
GILL, L. ... ..	c Stalybridge
GREENWOOD, W. ... ..	Todmorden
GRIMSHAW, A. ... ..	c Middleton
GUTHRIE, W. H. ... ..	Clitheroe
HALKYARD, C. ... ..	c Manchester
HALL, J. ... ..	c Oldham
HALLIWELL, P. ... ..	Walton-le-Dale
HANNAN, W. I. ... ..	Chorley
HANSON, J. ... ..	c Sowerby Bridge
HARDMAN, A. ... ..	Lees
HARDMAN, W. ... ..	Shaw
HARGREAVES, J. ... ..	Stalybridge
HAYLEY, J. W. ... ..	Morecambe
HEALEY, A. ... ..	c Rochdale
HEYS, E. E. ... ..	c Manchester
HIRST, B. ... ..	c Huddersfield
HODGKINSON, M. ... ..	c Chorley
HOLLAND, J. ... ..	c Bolton
HOLMES, J. ... ..	c Burnley
HUNT, J. ... ..	Shaw
JONES, J. S. ... ..	c Chadderton
KENYON, W. ... ..	c Bury

KERFOOT, J. T.	...	Manchester
LAITHWAITE, R.	c	Atherton
LINGARD, A.	...	Todmorden
LIVSEY, W. R.	...	Heywood
LOMAX, J. W.	c	Bolton
LORD, W.	...	Oldham
MARSHALL, P.	...	Hyde
MITCHELL, T. E.	c	Todmorden
MORRIS, J.	...	Bolton
MORRIS, J. E.	c	Shaw
MOTTRAM, J.	...	Oldham
NEVILLE, H.	c	Blackburn
NIRAIN, SHIV.	...	Manchester
PAINE, J. J.	...	Hollinwood
PARKER, W. E.	c	Heywood
PLATT, R.	c	Walkden
POLLITT, G. B.	...	Heywood
PRESTON, J.	...	Bury
PRESTON, R. S.	...	Burnley
REDFORD, A.	...	Droylsden
ROBINSON, B.	c	Middleton
ROBINSON, F. W.	c	Manchester
ROSTRON, R. S.	...	Rochdale
ROWBOTTOM, E.	...	Shaw
SCHOLEFIELD, W.	...	Chadderton
SCHOLICK, H. W.	c	Blackburn
SEED, E.	...	Halifax
SKINNER, G.	...	Bolton
SMITH, G. R.	...	Ossett
STOTT, J.	...	Manchester
STOTT, T.	...	Todmorden
SUGDEN, E. H.	...	Brighouse
SUTCLIFFE, H.	c	Paisley
TASKER, J.	c	Preston
TAYLOR, R.	...	Oldham
THORNLEY, T.	c	Bolton
THORNLEY, W.	c	Bolton
THORPE, J.	...	Oldham
TURNBULL, J.	...	Blackburn
TURNER, W.	...	Wigan
TWEEDALE, H.	...	Manchester
WARD, S.	c	Manchester
WATSON, W.	...	Salford
WEBB, R. H.	c	Accrington
WELLS, H.	...	Wigan
WHALLEY, B.	...	Preston
WHITEHEAD, H.	c	Milnrow
WHITELEY, J. A.	...	Sowerby Bridge
WHITTAKER, J. B.	...	Burnley
WINTERBOTTOM, J.	c	Manchester
WOODHOUSE, T.	...	Dundee
WOODLEY, J.	...	Stalybridge
WORSLEY, J.	...	Chorley
WRIGLEY, E.	c	Oldham

## Cotton Weaving.

ABBOTT, H.	c	Bolton
ADAMSON, J. E.	...	Preston
AINLEY, A.	...	Lockwood
ATKINSON, E.	...	Bradford
BAILEY, J.	...	Keighley

BARON, A. E.	...	Bacup
BARRETT, E.	...	Rochdale
BRADBURY, F.	...	Belfast
BROMLEY, A.	...	Hollinwood
BROOKES, H.	c	Farnworth
BROOKES, J.	...	Walkden
BROOKS, C. E.	...	Blackburn
BROOKS, C. P.	...	Blackburn
BULLOUGH, H. H.	...	New Mills
BUTTERWORTH, G.	...	Ashton-under-Lyne
CARTER, T.	...	Chorley
CHADWICK, A.	...	Littleborough
CHARNLEY, W.	c	Todmorden
COCKCROFT, E. E.	c	Hebden Bridge
COCKCROFT, J. W.	c	Hebden Bridge
CRABTREE, A.	...	Todmorden
CRANKSHAW, W. P.	c	Salford
DAVENPORT, R. J.	...	Wigan
DILWORTH, P.	c	Heywood
DUXBURY, T.	...	Bolton
DYSON, W.	...	Ashton under-Lyne
FELL, T.	c	Oswaldtwistle
FOX, T. W.	c	Manchester
GRIMSHAW, A.	...	Middleton
HANNAN, W. I.	...	Chorley
HARGREAVES, A.	c	Nelson
HARGREAVES, W.	...	Padiham
HARTLEY, J. R.	c	Padiham
HEY, J. M.	...	Oswaldtwistle
HEYLIN, H. B.	...	Bolton
HEYS, E. E.	...	Manchester
HILTON, H.	...	Hollinwood
HODKINSON, A.	...	Longridge
HOLDEN, R.	c	Darwen
HOLGATE, B.	c	Nelson
HOLMES, J.	...	Burnley
HORROCKS, F. W.	...	Bolton
HORSFALL, E.	...	Nelson
HOUGH, W.	...	Farnworth
HULME, T.	c	Rochdale
KENDAL, W.	...	Barrowford
KERSHAW, J.	c	Darwen
KNOWLES, J. B.	c	Glossop
LANCASTER, W. W.	...	Skipton
LAW, D.	...	Haslingden
LEAVER, A.	c	Nelson
LEE, A.	c	Manchester
LEE, E.	...	Nelson
LEECH, G. S.	c	Dukinfield
MARSHALL, P.	...	Hyde
MAXWELL, W.	c	Bury
MELLOR, W.	c	Preston
MITCHELL, T. E.	c	Todmorden
MOLYNEAUX, I.	...	Ashton-under-Lyne
MONCRIEFF, W.	...	Preston
MUTCH, J.	c	Skipton
MYERS, W.	c	Manchester
NEVILLE, H.	c	Blackburn
NIRAIN, SHIV.	...	Manchester
NISBET, H.	c	Bolton
NUTTER, H.	c	Nelson
OPENSHAW, O. H.	...	Bury

PICKERING, G. H.	...	Bacup
POLLITT, G. B.	...	Heywood
PRESTON, R. S.	c	Burnley
ROSTERN, J.	...	Radcliffe
SCHOFIELD, J. A.	...	Bolton
SCOTT, W.	...	Padiham
STEPHENSON, R.	c	Todmorden
STOCKWELL, L.	...	Walkden
STODDART, W.	c	Gt. Harwood
STOTT, J.	...	Manchester
TAYLOR, L.	c	Chorley
THORNLEY, T.	...	Bolton
TINDALL, A. R.	...	Trowbridge
TRIFFITT, A.	...	Kearsley
TURNER, H.	...	Hyde
TWEEDALE, H.	...	Manchester
VICKERS, W.	...	Hyde
WALTON, J. H.	c	Chorley
WATSON, W.	c	Glasgow
WEST, E. T.	...	Nelson
WHITHAM, M. R.	c	Stockport
WILBRAHAM, C.	...	Radcliffe
WILKINSON, W.	c	Clitheroe
WOODHOUSE, T.	...	Dundee
WOOLLEY, J.	...	Stalybridge

## Dressing of Skins.

BLOCKEY, F. A.	...	Bolton
HOUGH, A. T.	...	London
JACKSON, J. T.	c	London
LAMB, M. C.	c	London
TURNER, J.	...	Walsall

## Dyeing.

(Cotton, Wool, and Silk.)

APPLEYARD, J. R.	...	Salford
F.C.S.	...	c
ASHWORTH, A.	...	Middleton
BAKER, A.	...	Darwen
BRIGGS, R. H.	c	Bury
BUTTERWORTH, G. F.	...	Radcliffe
CHAMBERLAIN, J.	c	Leicester
CLAYTON, E.	c	Belfast
COPE, F.	...	Dewsbury
CROOK, C. A.	c	Halifax
DAVIES, A. H.	M.Sc.	Kidderminster
DAVIES, C. B.	c	Radcliffe
DEAN, H.	...	Huddersfield
DECHAN, M.	F.I.C.	c Hawick
DENNIS, L.	...	Halifax
EWING, A.	...	Ramshotbottom
FORT, M.	...	Keighley
GERLAND, C.	M.Sc.	Accrington
HALL, R. J.	...	Liscard
HANDLEY, B.	...	Oswaldtwistle
HARDCASTLE, G. F.	c	Leicester

HEY, H.	...	c Dewsbury
HEYWOOD, J. H.	F.C.S.	Rochdale
HOLDEN, G. E.	c	Middleton
HOPKINSON, C.	...	Batley
HÜBNER, J.	M.Sc.	Manchester
JACKSON, W. B.	...	Glasgow
LILEY, R. B.	...	Wakefield
LODGE, E.	...	c Huddersfield
MARSHALL, W.	...	Manchester
MATHER, J. H.	...	Bolton
NICHOLS, J. A.	...	New Mills
OLDROYD, R. E.	...	Halifax
OLIVER, T.	D.Sc.	c Galashiels
PARKES, G. A.	...	Belfast
POYSER, A. W.	...	Wisbech
RAY, W.	...	Manchester
RIDDING, H. C.	...	Redruth
ROBERTS, H. D.	...	Rochdale
ROSTRON, H.	B.Sc.	...
F.C.S.	...	Bolton
TATTERSFIELD, J. B.	c	Batley
TURNER, A.	...	New Mills
WHEWELL, G.	F.I.C.	Blackburn
WHITESIDE, J. L.	c	Bolton
WILSON, A.	M.Sc.	c Rochdale
YATES, G. T.	c	Paisley

## Electrical Engineering.

ABELL, C. E.	c	Worcester
ALLEN, E. E.	c	Bournemouth
ANDERSON, T. S.	...	Sheffield
APPLETON, W.	...	Hebburn
ARCHER, R. M.	c	Derby
ASHTON, A. W.	M.Sc.	c London
ASHWORTH, J. R.	...	...
M.Sc.	c	Rochdale
BAILLIE, T. C.	M.A.	...
D.Sc.	...	c Croydon
BAILY, F. G.	M.A.	c Edinburgh
BARLOW, T. M.	...	Stafford
BARNES, J. E. L.	c	Birkenhead
BARNES, W. A.	c	Horwich
BOWER, W. R.	...	...
A.R.C.S.	...	c Huddersfield
BRAY, W. H.	...	c London
BROOKS, E. E.	...	Leicester
BROOKS, W. S.	c	Norwich
BROOM, G. H.	B.Sc.	...
DERBY	...	c Derby
BROUGHTON, H. H.	c	Brighton
BROWN, W.	B.Sc.	...
DUBLIN	...	c Dublin
BURNIE, W. B.	c	Croydon
CHAPMAN, F. T.	c	Pudsey
CLAYTON, A. E.	B.Sc.	c Leicester
COALES, J. D.	D.Sc.	c Wolverhampton
COLLARD, J. F.	...	Aldershot
COOKE, A. G.	c	London
COOPER, A. G.	...	Colne
COOPER, A. R.	c	Lincoln

COTSWORTH, H. G. c	Wigan	JAMIESON, A. ...	Glasgow
COULTAS, P. C. ...	Birmingham	JEFOOAT, C., A.R.C.S.	Belfast
CRAPPER, E. H. ...	Sheffield	JENKINS, H. C.,	
CUMMING, A. G. G. c	Edinburgh	A.R.S.M. ...	Redruth
CUMMINS, C. P. C. ...	Ringsend	JENNISON, M. c	Grimsby
DAVIES, D. O. S. ...	Norwich	JOHNSON, C. B. c	Darlington
DAVIES, H., B.Sc. c	Portsmouth	JOHNSON, E. J. ...	Sheffield
DENNIS, G. P. c	Liverpool	JOLLY, A. C. ... c	London
DENTON, F. M.,		JUDE, R. H., M.A.,	
A.C.G.I. c	London	D.Sc. ...	Newcastle-on-Tyne
DIXON, E. H., B.Sc. c	Southampton	KELSEY, W. R., B.Sc.	Taunton
DOVER, A. T. c	London	KENNARD, F. E. c	London
DOWSE, C. M. c	London	KENNEDY, M. S. ...	Swindon
DRYSDALE, C. V.,		KINNES, C. B. ...	London
D.Sc. ...	London	LARK, W. J. ... c	Largan
EDGAR, F. J. ...	Acton	LARKMAN, A. E. ...	Southampton
FALKENSTEIN, C. K.	Tulse Hill	LEAPER, C. J. ...	Galway
FIRTH, W. W. c	Newcastle-on-Tyne	LOCK, A. C. ... c	Tottenham
FRIEDLAENDER, P. R. c	West Ham	LOGAN, H. T. ...	London
FRISBY, W. ...	Colchester	LUSTGARTEN, J. S.,	
GANNON, W., M.A. ...	Woolwich	M.Sc. ... c	Manchester
GEE, J. A. ...	Manchester	MACCALL, W. T.,	
GEE, W. W. H., M.Sc.	Manchester	M.Sc. ... c	Sunderland
GILBERT, L. B. ...	Darlington	MACDONALD, G. J. c	Portsmouth
GITTENS, G. E. c	Preston	MACLEAN, M., M.A.,	
GOOCH, H., B.Sc. c	Newcastle-on-Tyne	D.Sc. ... c	Glasgow
GOOD, P., A.C.G.I. c	Kingston-on-Thames	MAKOWER, A. J. c	London
GREEN, B. ...	Loughborough	MANSBRIDGE, G. F. ...	Croydon
GREENSLADE, C. E. c	Cork	MARSHALL, A. W. ...	London
HAIGH, B. P., B.Sc. c	Paisley	MATTHEWS, R. B. c	Stratford
HALFORD, F. W.,		MCBRENEY, W.,	
B.Sc. ... c	Handsworth	B.Sc. ... c	Lancaster
HARDY, J. H. c	Wakefield	MCDONALD, C., M.A.	Leith
HARRIS, S. H. c	Erith	MILLS, H. L. ...	Southampton
HASLAM, A. P. ...	London	MONAGHAN, T. J.,	
HAWORTH, H. F.,		B.Sc. ...	Limerick
M.Sc. ... c	London	MORPHY, B. H. c	Lordon
HAY, A., D.Sc. ...	Hackney	MORRIS, J. T. c	London
HENDERSON, H. ...	Consett	MORRISON, F. c	Coatbridge
HENDERSON, J. c	London	MUNDELLA, V. A. ...	Sunderland
HEWITT, F. W., M.Sc.	London	MURDOCH, W. H. F. c	London
HIBBERT, W. c	London	MYER, B. L. ... c	Runcorn
HIRST, H., M.Sc. c	Gillingham	OSCHWALD, U. c	London
HIRST, J., B.A. ...	Stafford	PEARSON, G. A. c	Hull
HOBART, H. M. c	London	PEARSON, R. L. ...	Reading
HOBBS, W. R. P. ...	Southsea	PEERS, G. R. ...	Manchester
HOLDEN, A. W. c	Preston	PHILLIPS, E. D. ...	East Ham
HOLT, F. B. ...	Derby	PILLING, J. ... c	King's Lynn
HOPWOOD, A.,		PRIDEAUX, W. H. C.	Loughborough
A.R.C.S. ...	Tunstall	QUICK, J. ...	Folkestone
HOWARD, J. W.,		RHODES, W. G., D.Sc. c	Salford
M.Sc. ... c	Stafford	RILEY, T. N. ... c	Plymouth
HUNTER, F. W. ...	Houghton-le-Spring	ROBERTSON, D., B.Sc. c	Bristol
HUTCHINSON, R. W. c	Smethwick	ROBSON, W. E. ...	London
IBBETSON, W. W. S.,		ROBSON, W. G. ...	Dundee
B.Sc. ... c	London	RUDD, S. ... c	Huddersfield
ISAACS, R. G., B.Sc. c	Bath	RYCROFT, C. W. ...	London
ISHERWOOD, W. H. ...	Leeds	SADD, J. A., A.C.G.I. c	Halifax
JACKSON, H. A. ...	East Kirkby	SCHOFFIELD, J., B.Sc. c	Huddersfield
JAGGER, J. E., M.Sc. c	Failsworth	SEWELL, T. ... c	London
JAMES, W. H. N. c	Bradford	SHAW, F. ... c	Manchester
		SHORT, E. W. ...	Dewsbury

SMITH, E., B.Sc., A.R.C.S. ...	c	Leyton
SMITH, S. B., B.Sc. ...	c	Stafford
STANLEY, R., B.A. ...	c	Belfast
SUMPNER, W. E., D.Sc. ...	c	Birmingham
SWIFT, G. E. ...	c	Chester
TAYLOR, C. A. ...	c	London
TAYLOR, F. H. ...	c	London
TEMPLETON, W. S., M.A., B.Sc. ...	c	Devonport
THOMPSON, J. J. ...	c	Thrapstone
THORNTON, W. M. ...	c	Newcastle-on-Tyne
TOMLINSON, T. ...	c	Ringsend
TURNER, P. W. ...	c	London
TURNER, W., B.Sc. ...	c	Aston Manor
WADSWORTH, T. ...	c	London
WAITE, F. L. ...	c	Swindon
WILMSLEY, R. M., D.Sc. ...	c	London
WALTON, W. H. ...	c	Southport
WATKINS, S. S. A., A.C.G.I. ...	c	London
WHITAKER, F. P. ...	c	Rugby
WHITEHOUSE, W. H. ...	c	Newport (Mon.)
WILLIAMS, O. J., B.Sc. ...	c	Bristol
WILSON, J. A., M.A., B.Sc. ...	c	Aberdeen
WILSON, J. M. F. ...	c	Belfast
WRIGHT, C. H. ...	c	Chelmsford
YORKE, J. P. ...	c	London
YOUNG, A. P. ...	c	Rugby

### Electric Wiremen's Work.

ABELL, C. E. ...	c	Worcester
APPLETON, W. ...	c	Norwich
CHEESEMAN, A. H. ...	c	Acton
COTSWORTH, H. G. ...	c	Wigan
COXON, J. ...	c	Redhill
DENNIS, G. P. ...	c	Liverpool
EDGAR, F. J. ...	c	London
FAULKNER, H. O. ...	c	Kingston-on-Thames
GLANVILL, H. G. ...	c	Smethwick
GOOD, P., A.C.G.I. ...	c	Kingston-on-Thames
GRAY, E. B. ...	c	Colchester
GREENSLADE, C. E. ...	c	Cork
HAMPSHIRE, P. M. ...	c	Blackburn
HENRY, J. ...	c	Falkirk
HOPWOOD, A. ...	c	Tunstall
ISHERWOOD, W. H. ...	c	Leeds
LILLEKER, J. R. ...	c	Rotherham
MATTHEWS, C. H. ...	c	Barnsley
MAYCOCK, W. P., M.I.E.E. ...	c	London
O'KEEFE, M. ...	c	Dublin
PEARSON, G. A. ...	c	Hull
PILLING, J. ...	c	King's Lynn

PRICE, E. C. ...	c	Croydon
RAWLINGS, C. ...	c	London
RUDD, S. ...	c	Huddersfield
RYCROFT, C. W. ...	c	London
SAMPSON, T. W. ...	c	Barnsley
TAYLOR, C. A. ...	c	London
VORMEISTER, C. E. ...	c	Salford
WHITEHEAD, H. J. ...	c	London
WILSON, J. M. F. ...	c	Belfast

### Electro-Metallurgy.

BAKER, T. J. ...	c	Birmingham
BARCLAY, W. R. ...	c	Sheffield
CARE, B. ...	c	Sheffield
CLARK, C. R. ...	c	Birmingham
COLEMAN, H. S. ...	c	Smethwick
FIELD, S. ...	c	London
GANNON, W., M.A. ...	c	Woolwich
GEE, W. W. H., M.Sc. ...	c	Manchester
HARRIS, J. ...	c	Swansea
HIGGINS, A. H. ...	c	Birmingham
HUNTER, F. W. ...	c	Durham
INNES, J. ...	c	Llanelli
LEAPER, C. J. ...	c	Galway
PLATTS, J. C. ...	c	Manchester
SEXTON, A. H. ...	c	Glasgow
WHITEHOUSE, W. ...	c	Wolverhampton
YOUNG, T. S. ...	c	Walsall

### Engineers' Quantities and Estimating.

BRITTON, G. ...	c	Bristol
DUNN, J. ...	c	Leeds
HILL, S. F. ...	c	Darlington
LARARD, C. E. ...	c	London
WILKES, J. E. ...	c	Birmingham

### Engraving for Calico Printers.

WEIR, A. ...	c	Manchester
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### Flax-Spinning.

BRADBURY, F. ...	c	Belfast
CAIRNS, R. ...	c	Belfast
GIBSON, W. ...	c	Belfast
KINNEAR, P. M. ...	c	Arbroath
THOMSON, J. W. ...	c	Kirkcaldy
WALLACE, E. ...	c	Belfast
WOODHOUSE, T. ...	c	Dundee

### Framework Knitting and Hosiery.

BEECROFT, S. ...	c	Nottingham
BROWN, T., Jun. ...	c	Glasgow
CHAMBERLAIN, J. ...	c	Leicester
MAYFIELD, H. B. ...	c	Heanor

NEALE, G. H.	...	Loughborough
QUILTER, J. H.	c	Leicester

STAPLETON, H.	...	London
TULLY, B. J.	...	c London
WARE, E. T. W.	c	London
WIGLEY, T. B.	...	Birmingham

### Gas Engineering and Supply.

ASHWORTH, J. D.	...	Portsmouth
ASTBURY, E.†	c	Liverpool
BARNES, F. V.	...	Nottingham
BERRY, A. G. Y.*	c	East Ham
BUCKLEY, W.	c	Old Trafford
CHAMBERLAIN, H.	c	Hull
CLARK, J. G.*	c	London
COLLINS, R. H.	c	London
CRANFIELD, W.	c	Halifax
CRANMER, W. G. S.	c	Birmingham
DAVIDSON, W. B.	c	Birmingham
DEAN, W. E.	c	Torquay
DOUGALL, A.	...	Hull
GARLICK, R. H.	c	Manchester
GIBSON, R. E.	...	Liverpool
GRAFTON, W.	...	London
GREEN, W. H.	...	Bournemouth
HALLIWELL, S. E.	...	Littleborough
HEYWOOD, J. H., F.C.S.	...	Rochdale
HOLGATE, T.	c	London
HOLLINGWORTH, D. V.	...	c Salford
HORNBY, J., F.I.C.	...	Beckton
HOSKINS, A. P., F.I.C.	...	Belfast
HOUGHTON, R. V. S.	...	Helmsshore
LEES, H.	...	Newcastle-on-Tyne
MILBOURNE, R. J.	...	Newport (Salop)
MITCHLEY, J. W.*	c	Kings Lynn
OAKDEN, W. E.	...	London
O'CONNOR, H.	c	Edinburgh
O'SHAUGHNESSY, B.	...	Waterford
PEARCE, F. J.	c	Bath
PETTIGREW, W. E.	c	Leeds
POPHAM, F. J. W.†	...	East Ham
POWER, J.	...	Sheffield
SMITHERS, P. J.*	c	London
SUTCLIFFE, E. J.	...	Bradford
THOMPSON, W. E.*	c	Liverpool
TWIGG, G. F.	c	Derby
WALMSLEY, P. D.†	c	Barnsley
WEBBER, W. H. Y.*	c	Tottenham
WILDE, W.	...	Manchester

\* Registered for Gas Supply only.

† Registered for Gas Engineering only.

### Glass Manufacture.

CARDER, G. J.	c	Brierley Hill
PATERSON, O.	...	Glasgow
WICKS, H.	...	Wordsley

### Goldsmiths' Work.

CANDELENT, E. J.	c	London
INSTONE, L.	c	Birmingham

### Heating and Ventilation.

BARKER, A. H., B.A., B.Sc.	...	c London
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### Iron and Steel Manufacture.

ABBOTT, V. F.	c	Wigan
ANGLIN, W.	...	Middlesbrough
ARNOLD, Prof. J. O.	...	Sheffield
BAKER, T.	...	Llanelli
BOWMAN, W. H. M.	...	Barrow-in-Furness
BURRELL, B.A., F.I.C.	c	Leeds
CHALONER, G.	...	London
CHRISTOPHER, J. E.	...	Wigan
DAVIES, A. E.	...	Bilston
EDWARDS, J. J.	...	Plumstead
FARLIE, J. B.	...	Old Charlton
GOODSELL, J. C.	...	Llanelli
HAMPTON, W. E.	...	Newcastle-on-Tyne
HATFIELD, J. A., F.I.C., F.C.S.	c	Newport, Mon.
HEAD, G. H.	...	Tipton
HENDERSON, J.	...	Eaglescliffe
HIORNS, A. H.	c	Birmingham
HOARE, A. C.	...	Bilston
HUNTER, F. W.	...	Durham
HUNTING, F. F.	c	Stoke-on-Trent
INNES, J.	...	Llanelli
KILLIN, T.	...	Glasgow
LAMBERT, W. J.	c	London
LATHAM, W. B.	...	Crewe
LAVENDER, J. H.	c	Barrow-in-Furnace
LAWN, J. G.	...	Camborne
MACFARLANE, W. C.	c	Wednesbury
MARKS, A., A.R.C.S., A.R.S.M.	...	c St. Helens
MELLAND, G.	c	Woolwich
MITCHELL, J.	c	Coatbridge
MORGAN, J. J.	...	Workington
MUNNOCH, P.	...	Middlesbrough
PRESKOTT, H. R.	...	West Bromwich
RANKIN, T. T., B.Sc.	...	Wigan
REDDING, R. J., F.C.S.	...	Woolwich
RHEAD, E. L.	c	Manchester
ROBINSON, A.	c	Scunthorpe
ROSE, C. H.	...	Doncaster
RUDDOCK, F. G.	...	Warrington
SAVAGE, W.	...	Crewe
SEXTON, A. H.	...	Glasgow
SHERBURN, H.	...	Warrington
SPENCER, R., F.C.S.	...	Barrow-in-Furness
STANSBIE, J. H., B.Sc.	c	Birmingham
WHITE, C. A., B.Sc.	c	Aston Manor

WHITEHOUSE, W. c Wolverhampton  
 WILLEY, G. B., c Rotherham  
 A.R.S.M. ... c Rotherham  
 WILLIAMS, D. ... Llanelly  
 WILLIAMSON, S. W. Leeds  
 WILLIS, G. W. ... Barrow-in-Furness  
 WILLIS, W. J. ... Barrow-in-Furness  
 WRIGHT, H. E., F.C.S. Middlesbrough

### Jute Spinning.

FERGUSON, T. ... Dundee  
 GIBSON, W. ... Belfast  
 KILGOUR, P. c Dundee  
 KINNEAR, P. M. ... Arbroath  
 MACDONALD, D. J. ... Dundee  
 MILNE, T. ... Dunfermline  
 WOODHOUSE, T. ... Dundee

### Jute Weaving.

FERGUSON, T. ... Dundee  
 HEYS, E. E. ... Manchester  
 KINNEAR, P. M. ... Arbroath  
 MACDONALD, D. J. ... Dundee  
 MILNE, T. ... Dunfermline  
 WOODHOUSE, T. c Dundee

### Lace Manufacture.

HARPHAM, W. c Nottingham

### Leather Dyeing and Finishing.

HOUGH, A. T. ... London  
 JACKSON, J. T. c London  
 LAMB, J. W. ... London  
 LAMB, M. C. ... c London

### Leather Tanning.

BLOCKEY, F. A. c Bolton  
 FALKENSTEIN, C. K. Tulse Hill  
 HAMP, W. ... Northampton  
 HOUGH, A. T. ... London  
 LAMB, M. C. ... London  
 LEVITT, J. W. ... Walsall  
 TURNER, J. ... c Walsall  
 VAN GYN, J. L. ... London

### Linon Weaving.

ADDY, J. T. c Belfast  
 ADDY, J. T. ... c Lurgan  
 BELLE, M. ... Halifax  
 BRADBURY, F. c Belfast  
 LIVINGSTON, H. c Belfast

MILNE, T. ... c Dunfermline  
 WALTON, J. ... c Dunfermline  
 WOODHOUSE, T. c Kirkcaldy

### Lithography.

ASHMAN, H. W. ... Derby  
 CHRISTIAN, W. ... Leeds  
 FLETT, G. ... Edinburgh  
 GOODMAN, J. c Liverpool  
 HARRAP, C. ... c London  
 HONEYMAN, J. ... Liverpool  
 HURWITZ, F. c Harrow  
 ROBERTSON, A. D. c Edinburgh  
 WELLS, J. ... c Leicester  
 WIDDOWSON, T. B. ... Leicester

### Masonry.

ARNALL, G. ... c London  
 BARHAM, G. R. c London  
 BATES, E. L. ... London  
 BURLINGTON, E. J. A. ... c London  
 BURNS, D. ... Pollokshaws  
 BUSBRIDGE, H., A.R.I.B.A. ... London  
 CARR, R. ... Hyde  
 CORBEN, F. ... London  
 DEAKIN, W. ... Manchester  
 DIXON, W. M. ... London  
 DUNN, J. G. ... c Glasgow  
 EVANS, S. ... Croydon  
 FLINT, H. ... London  
 GORST, T. B. ... Lancaster  
 GOURLAY, C., B.Sc., A.R.I.B.A. ... Glasgow  
 GRAY, D. ... Loches  
 GRUBE, H. C. ... Bromley  
 HALLIDAY, J. c Keighley  
 HODGSON, H., A.R.I.B.A. c Bradford  
 HOLMES, B. ... Keighley  
 JAMISON, J. ... Belfast  
 JESSIMAN, J. ... Elgin  
 JOHNSON, W. H. ... London  
 JONES, A. ... Leeds  
 JONES, D. P. ... Llandaff  
 KIRK, J. W. ... London  
 LAWSON, A. C. ... Manchester  
 LIDDELL, R. W. ... North Shields  
 LYONS, P. c Newcastle-on-Tyne  
 MADDERN, H. ... Penzance  
 MADDOX, F. E. ... Bristol  
 MARSDEN, R. E. ... London  
 MARTIN, T. ... c Coatbridge  
 MASTERS, W. H. ... Southampton  
 MILLAR, J. ... London  
 MILLICHAPE, A. F. c London  
 MITCHELL, G. A. c London



NARIE, J. ...	Glasgow
NEIL, W. W. ...	London
NEWMAN, A. H. ...	London
OLDERSHAW S. B. ...	Lincoln
PHILLIPS, H. ...	Norwich
POLLINGER, W. T. c	London
PYE, F. J. ...	Preston
QUIBELL, E. ...	Hull
STOTT, J. ...	Leigh
STOTT, JULIUS ...	Newton Heath
TAYLOR, F. R. ...	London
WARRINGTON, J. c	Leeds
WHEWELL, M. c	Blackburn
WHINCUP, W. T. c	York
WHITEHEAD, R. D. c	Derby
WILDING, J. c	Liverpool
WORNELL, J. ...	Beckenham
WORTHINGTON, E. ...	Peterborough

### Mechanical Engineering.

ADAMS, H., M.I.C.E. ...	London
ALEXANDER, A. D., A.R.C.S., W.L.S. ...	Sunderland
ALLEN, C. C. ...	Coventry
ALTON, W. R. ...	Darlington
ANDREW, H. ...	Woolwich
ARMSTRONG, G. E., M.Sc. ...	Londonderry
ASTON, J. W. c	Birmingham
BACON, F., M.A., A.M.I.E.E. ...	London
BAGGS, E. ...	Bath
BAILEY, R. W. ...	London
BARRETT, A. ...	West Hartlepool
BATES, U. ...	Salford
BAXTER, J. H. ...	Old Trafford
BEALE, S. H. ...	Banbury
BELL, D. Q., A.M.I.C.E. c	Paisley
BERRY, F. ...	Bolton
BERRY, W. E. ...	Hyde
BILLINGHAM, O. ...	Tipton
BILLINGTON, J. R. c	Horwich
BOULDEN, F. ...	Sheffield
BROADBENT, F. J. ...	Bristol
BROCKLEBANK, G. H. ...	Millom
BROWN, R. M., B.Sc. c	Paisley
BUCKLEY, P. ...	Leeds
BURN, G. F. ...	Leeds
CABENA, R. H. c	Croydon
CHAPMAN, S. ...	Droylsden
CLARK, A. G. c	London
CLARK, H. A. c	London
COLLINS, E. L. c	London
COOK, A. W., B.Sc. ...	St. Helens
COSTON, E. P., B.Sc. ...	St. Helens
COUESLANT, L. D., B.Sc. ...	Sunderland
COWLEY, G. F. A. ...	Rotherham
CRAPPER, E. H. ...	Sheffield
CRAIG, G. M., B.Sc. c	Paisley
CURNOCK, W. E. M., B.Sc. ...	London
CURRIE, J. H. c	London
CURRY, N. ...	Camborne
CURTIS, R. ...	London
DALE, A. F. ...	Halifax
DALE, J. ...	Darlington
DANIELS, W. ...	Gorton
DAVENPORT, J. A. ...	St. Helens
DAVIES, V. C., B.Sc. c	London
DAVY, C. R. ...	Leeds
DAY, A. G. ...	Bath
DEVILLE, M. ...	Coulsdon
DOBBIE, A. B. ...	Glasgow
DOBBIE, J. ...	Wig
DODRIDGE, F. c	Livermouth
DOWLING, J. ...	Barnstaple
DRAYCOTT, G. E. ...	London
DUNCAN, J. ...	London
DUNCAN, J. ...	West Ham
EAGLES, J. ...	Darlington
EDWARDS, J. G. ...	Leeds
ELLISON, W. ...	Perth
FEARNLEY, G. W. ...	Cork
FENNING, R. W., B.Sc. c	London
FERRIER, R. M., M.Sc. ...	Bristol
FORTH, F. C., A.R.C.S. ...	Belfast
FRANCE, N. E., B.Sc. ...	Warrington
GARRATT, H. A. c	London
GARSDIE, J. ...	Widnes
GIBSON, R. ...	Dundee
GLADWYN, A. E. c	Woolwich
GOVIER, R. E. ...	Plymouth
GOW, W. J., A.R.C.S. c	London
GRACE, G., B.Sc. ...	Barrow-in-Furness
GREAVES, J. E. E. ...	Rochdale
GREEN, F. W. ...	Newcastle-on-Tyne
GREENHALGH, S., M.Sc. ...	Bolton
GRIFFITHS, D. N. c	Darlington
HALER, P. J., B.Sc. c	Hackney
HARDY, J. H. ...	Halifax
HENDERSON, J. N. c	South Shields
HIDER, G. E. c	Dartford
HOCKING, E. C. ...	Colchester
HONIBALL, C. R. ...	Liverpool
HOUSTON, W. C., B.Sc. c	London
HOWARTH, E., B.Sc. ...	Hackney
HOWELL, H. F. c	Woolwich
HUBBLE, A. ...	London
HUNTER, C. F. ...	Sunderland
ISAACS, R. G., B.Sc. c	Bath
JAMIESON, A. ...	Glasgow
JAMIESON, J. B. c	Rotherham
JEFcoat, C., A.R.C.S. ...	Belfast
JEWELL, J. ...	Plymouth
JOHNSON, L. ...	Stockton-on-Tees
JORDAN, H. G. c	Manchester
KER, J. S. ...	Woolwich
KERSEY, A. T. J., A.R.C.S. ...	Halifax

KERSHAW, G.	c	Rochdale
KING, C. A., A.R.C.S.	c	Sunderland
KIRK, P.	...	Hackney
LAMB, S. E., B.Sc.	...	Portsmouth
LAMBERT, W. G.	...	Darlington
LANDER, T.	...	Glasgow
LARARD, C. E.	c	London
LEES, J., A.R.C.S.	c	Bristol
LEFLUFY, E. M.	...	Ringsend
LINEHAM, W. J.	c	London
LLOYD, T.	...	New Quay, Cardigan
LONGLAND, W.	c	London
LORD, F., M.Sc., A.M.I.M.E.	...	Warrington
MACKEY, E. N.	...	Newcastle-on-Tyne
MACLACHLAN, D. R. c	...	Woolwich
MACLEAN, J. M.	c	Leith
MARKS, E. C. R.	...	Birmingham
MARKS, G. C.	...	Birmingham
MARSHALL, A. W.	...	London
MASTERTON, J. F.	...	Ashford
MATHER, J. H.	...	Bolton
MAYTUM, J. W.	...	Gillingham
MCCOWATT, J. S.	...	Paisley
MCCURDY, J. H.	...	London
MCLAREN, W. D.	c	Paisley
METCALFE, C. S.	...	Sunderland
MILLER, D. J.	c	Grimsby
MILLIS, C. T.	...	London
MINSHULL, J. W.	...	Kilkenny
MONAGHAN, T. J., B.Sc.	...	Limerick
MORRIS, J.	...	Salford
MOWAT, A. G. T.	...	Barrow-in-Furness
MOWAT, W.	...	Barrow-in-Furness
MOYLE, E. C.	...	Preston
MUNBO, J.	...	Bristol
NEAGLE, W.	...	Erith
ODDY, J.	c	Smethwick
OLIVER, T., D.Sc.	c	Galashiels
OUTON, C. B.	...	Dublin
OWEN, S.	...	Hyde
PARSONAGE, W. R., B.Sc., A.M.I.M.E.	...	Sparkbrook
POULSON, H.	...	London
PRATT, R.	...	Barrow-in-Furness
PODESTA, J. J.	...	Wolverhampton
PULLEN, W. W. F.	...	London
RANKIN, T. T., B.Sc.	...	Wigan
RICHARDSON, D.	c	London
RICHARDSON, I. W.	c	Leeds
RICHIE, A. S.	c	West Ham
RIMMER, E. J., B.Sc., A.M.I.C.E.	...	St. Helens
ROBERTS, J.	c	Gorton
ROBERTSON, A.	...	Barrow-in-Furness
ROGERS, A. J.	...	London
ROGERS, F. R.	c	St. Helens
ROSCOE, J. R.	...	Little Hulton
SACKFIELD, T. E.	...	Crewe
SADD, J. A.	c	Halifax
SAVAGE, W.	...	Crewe

SEARS, S. A., B.Sc.	c	Worcester
SHAW, J. B.	...	London
SHEDDEN, W.	...	Paisley
SIMPSON, H. H., B.Sc.	c	Barrow-in-Furness
SINCLAIR, W. R.	c	South Shields
SPOONER, H. J.	c	London
STEELE, J. E.	c	London
SUTHERLAND, G. F., A.R.C.S.	...	Barrow-in-Furness
TAYLOR, J.	...	Dublin
TEAGUE, T.	...	Neath
TENNANT, W. J.	...	London
THRELFALL, H.	...	Manchester
TRELEAVEN, J. T.	...	London
TRUSTRUM, N. S.	c	London
TURNER, A. P.	...	Peterborough
WALKER, A.	c	West Ham
WALMSLEY, R. M., D.Sc.	...	London
WARD, W.	...	Queenstown
WARDEN, E. H.	...	Wolverhampton
WAREING, H. H.	c	Oldham
WATSON, F. R. B., B.Sc.	...	Bristol
WEBB, A. E., B.Sc.	c	Barrow-in-Furness
WHITE, G. T.	c	London
WHITE, J.	c	Wigan
WHITEHEAD, R. D.	c	Derby
WHITFIELD, E.	...	Woolwich
WHITTAKER, J. B.	...	Burnley
WIGHT, J. T.	...	Edinburgh
WILKINSON, G. R.	c	Northwich
WILLIAMS, A. D.	c	Aberystwyth
WORSEY, J. R.	c	Handsworth
WORTHINGTON, E.	...	Peterborough
WRIGHT, C. H.	...	Chelmsford

## Metal Plate Work.

AIRD, A.	...	Manchester
ALTON, W. R.	...	Darlington
ANDERBERG, A.	c	Birmingham
ATRINS, E. A.	c	Liverpool
BARLOW, E.	c	Todmorden
BENNETT, W. H.	...	London
BRACKLEY, A.	...	London
COCHRAN, J.	c	Glasgow
COPE, E.	...	Bury
DAVIES, W. J. D.	c	London
FRANCKLOW, W. H.	...	Wolverton
GORDON, W. E.	c	Belfast
GREENSLADE, G. T.	c	London
HENRY, J.	c	London
LEA, CHARLES	...	Ilfracombe
MACKENZIE, C. H.	...	London
MILLIS, C. T.	...	London
MOIR, J.	c	Woolwich
MOORE, G. H.	c	Birmingham
PAPPIN, G.	c	Dublin
TURNER, F.	...	Liverpool
WILLIAMS, A.	...	Crewe

## Milling (Flour Manufacture).

AMOS, P. A. ...	c	Manchester
BIRKS, T. ...	...	Nottingham
HALLIWELL, W. ...	...	Romford
HANCOX, F. J. ...	c	Gloucester
HURST, A. A. ...	c	Liverpool
SIDLEY, R. A. ...	c	West Ham
SPEIGHT, J. E. ...	...	West Ham
STAMFORD, F. H. ...	c	Hull
THOMPSON, J., Junr.	...	West Ham
VOLLER, W. R. ...	...	Gloucester

## Mine Surveying.

BAKER, G. ...	...	Bedlington
BONDS, E. ...	...	Redruth
BURNS, D. ...	...	Glasgow
CHARLTON, W. ...	c	Walsall
CHARLTON, W. J. ...	...	Ashington
COOK, T. C. ...	...	Spennymoor
COWX, H. F. ...	c	Wingate
DEAN, H. ...	c	Consett
DOXFORD, J. M. B. ...	c	Durham
FELTON, J. R. ...	...	Stanley
FOSTER, H. T. ...	...	Sheffield
GALLETLEY, W. H. ...	c	Wakefield
GILL, J. ...	...	Helston
GOMERSALL, J. E. ...	c	Batley
HARRIS, H. O. ...	c	Coatbridge
HENDERSON, C. G. ...	...	Ashington
JENKINS, H. C., A.R.S.M. ...	...	Redruth
KNOX, G. ...	c	Wigan
LAWN, J. G. ...	...	Camborne
LEATHARD, R. ...	...	Durham
LISTER, J. A. ...	...	Spennymoor
MAGEE, C. S. ...	...	Houghton-le-Spring
MILLWARD, A. E. ...	...	Accrington
MILSON, F. W. ...	c	Castleford
MORGAN, T. ...	...	Ebbw Vale
MORGANS, D. B., B.S.C. ...	...	Wigan
MORRIS, G. B. ...	...	Hetton-le-Hole
PERKIN, H. ...	...	Leeds
PESCOD, J. W. ...	...	Howden-le-Wear
RANKIN, T. T., B.S.C. ...	...	Wigan
RAWLIN, J. ...	c	Barnsley
RAWSON, W. ...	c	Burnley
RICHARDS, R. ...	...	Wigan
RIDLEY, G. D. ...	c	Newcastle-on-Tyne
ROBINSON, F. M. ...	...	Bishop Auckland
SHEEL, H. ...	c	Ferryhill
SMITH, E. A. ...	...	Sunderland
SMITH, T. H. ...	c	Sunderland
STATHAM, I. C. F. ...	c	Stafford
THOMAS, W., A.M.I.C.E. ...	...	Camborne
WALTON, W. H. ...	...	Walkden
WATSON, R. H. ...	c	Redruth
WIDDAS, P. ...	...	High Grange
WINSTANLEY, G. H. ...	c	Manchester
WOOD, F. W. ...	c	Wakefield

## Motor Car Engineering.

CHAMBERS, J. H. ...	...	Belfast
CLARK, A. G. ...	c	London
HEMINGWAY, W. ...	c	London
IRVING, J. S. ...	c	Wolverhampton
LAMBOURNE, A. ...	c	Brighton
LARARD, C. E. ...	c	London
MARSDEN, A. ...	c	London
MERCER, G. B. ...	c	Liverpool
MILLIGAN, J. L. ...	...	Luton
MITCHELL, J. C. B. ...	c	Leeds
MORGAN, W., B.S.C. ...	c	Bristol
RONCA, J. F., A.R.C.S. ...	c	London
SIDWELL, E. ...	c	Coventry
SIMMS, C. E. ...	...	Birmingham
SMITH, G. A. ...	c	Tunbridge Wells
SNODGRASS, D. G. ...	...	London
SPOONER, H. J. ...	c	London

## Occurrence, Raising, and Dressing of Ores.

BONDS, E. ...	...	Redruth
ENDEY, J. ...	...	St. Agnes
GRIGG, J. H. H. ...	c	Dalton-in-Furness
HARRIS, J. H. ...	...	Porthleven
JENKINS, H. C., A.R.S.M. ...	...	Redruth
LAWN, J. G. ...	...	Camborne
MICHELL, F. H. ...	c	Redruth
MORRIS, J. ...	...	Gorseinon
NICHOLAS, B. ...	...	Camborne
THOMAS, W., A.M.I.C.E. ...	...	Camborne
WILKINSON, W. F. ...	c	Camborne

## Oils and Fats.

ALLAN, J. ...	c	Manchester
DIXON, A. C., M.A., B.S.C. ...	...	Darlington
DILLON, W. ...	...	Leeds
FURNELL, J. T. ...	...	Walthamstow
GADD, W. L., F.I.C. ...	...	Gloucester
HALL, R. J. ...	...	Liscard
HOLDEN, G. E. ...	...	Middleton
NIGHTSCALES, T. A. ...	c	Hull
SMITH, G., B.S.C. ...	c	Newcastle-on-Tyne
WHITE, J. L. ...	c	London
WILSON, J. ...	...	London

## Painters' Oils, Colours, &amp;c.

ASTON, W. G. ...	c	London
CRANFIELD, W. ...	...	Halifax
FISHER, A. ...	...	Southsea
FURNELL, J. T. ...	c	Walthamstow

HARRISON, C.	c	London
NIGHTSCALES, T. A.	c	Hull
THEOBALDS, V. W.,		
F.I.C.	...	S. Norwood

## Painters' and Decorators' Work.

ANDERSON, W.	c	Dundee
ANDREWS, E. R. S.	...	Bradford
BARBER, W.	...	Macclesfield
BARRETT, W. S.	c	Bristol
BASKETT, C. E.	c	Colchester
BENSKIN, J. W.	...	Leicester
BRENNAND, C. E.	c	St. Helens
BROADBENT, T. E.	...	Leeds
BUNTING, W. R.	c	Grimsby
BURRELL, A.	c	Norwich
CANTRILL, W. H.	c	Manchester
CASTLE, A. J.	...	London
CLAYTON, H.	c	Leeds
COATES, A.	...	Shildon
COOKE, T.	...	Salford
COSTAR, E.	...	Croydon
DART, C.	...	Barnstaple
DAWSON, J. H.	c	London
DERRETT, J. W.	c	London
DOUGLAS, J.	...	Belfast
DRINKWATER, L.	c	London
ELLIS, R. J.	...	Chester
ELLISON, A.	...	Keighley
FITZGIBBON, D.	c	Cork
FOURNISS, W.	...	London
GARNER, H.	...	Stockport
GREENEP, J. A.	...	Bentham
GRIFFITHS, G. M.	...	Wolverhampton
HAINSWORTH, T.	c	Halifax
HARVEY, H.	...	Bristol
HILL, D.	...	London
HOWELLS, L. T.	c	Wigan
IRELAND, A. J.	c	London
JEWELL, R.	c	Rochdale
KILPACK, G.	...	Leyton
LAWLER, J. J.	...	Liverpool
LAWRANCE, J.	c	London
LAWTON, A.	...	Stoke-on-Trent
LAYCOCK, F. P.	...	Keighley
MANSFIELD, W.	c	Manchester
MAWSON, C., A.R.C.A.		Shipley
MCPHERSON, A.	...	Manchester
MILLER, J. J.	...	South Shields
MITCHELL, F. S.	...	London
OGILVIE, R.	...	Hamilton
PAGE, T.	...	London
PARKER, A.	...	Bristol
PERKINS, T. C.	c	Burton-on-Trent
PETRIE, C. R.	...	Hyde
PHIPPS, G. E.	...	Bishopstoke
RADCLIFFE, L. C.	c	London
RAY, C. W.	...	Southend-on-Sea
RAYNER, H. S.	c	Wakefield

RHODES, W.	...	Bradford
RIDDLE, W. H.	...	Manchester
ROGERS, A. H. N.	c	Bolton
SAYERS, T. H.	...	Bournemouth
SHOESMITH, W.	c	Nelson
SIMPSON, A.	...	Burnley
SPENCER, E. V.	...	Doncaster
SQUIRES, J. J.	c	Birkenhead
STONE, T.	...	Bingley
WARD, W.	...	Halifax
WATSON, H. F.	c	Rawtenstall
WATSON, W. C.	...	Torquay
WHITTAKER, R.	c	Southport
WILLIAMS, A.	c	London
WILLIAMS, I. J.	...	Merthyr Tydfil
WILLIAMSON, A.	...	Middlesbrough
WOODISON, G.	...	Wimbledon
WORTHINGTON, T. S.	c	York
WYLIE, J.	...	Ardrossan

## Paper Manufacture.

AITKEN, J. E.	c	Edinburgh
BACON, W.	...	London
BAKER, A.	...	Darwen
BRIGGS, J. F.	...	London
NICHOLS, J. A.	...	New Mills.
PEARSON, D.	...	Shotley Bridge
TEMPERLEY, A.	c	Bury
WHALLEY, A. A.	c	London
WHEWELL, G., F.I.C.		Blackburn

## Photography.

BANNISTER, F. W.	c	London
BENNETT, H. W.	c	Ilford
BOTTOMLEY, S. E.	c	Leeds
CRANK, W. T.	...	Bristol
DONOVAN, C.	c	Brighton
FARMER, E. H.	c	London
FIELD, A. G.	...	Acton
GEAR, J. H.	...	London
GOODMAN, J.	c	Liverpool
GOVER, H. J.	...	Hanley
HANDS, A.	...	Snaresbrook
HEYES, T. H.	...	Ulverston
HUNTER, F. W.	...	Durham
LEAPER, C. J.	...	Galway
LUTY, W. A.	c	Harrow
MCNEIL, J. N.	...	Blackburn
RIDD, W. J.	...	London
ROBINS, E. A.	c	Harrow
SENIOR, E.	...	London
SEXTON, A. H.	...	Glasgow
TIMS, J.	...	Ewell
WATTS, W. A.	...	London
WELLS, F. S.	...	Southgate
WHITEHOUSE, W.	...	Wolverhampton
WILKINSON, W. T.	...	London

## Plasterers' Work.

BACHELOR, W.	c	London
CHANNON, C. C.	c	London
COOPER, J. R.	...	Southport
DANIELL, J. B.	...	London
ERHORN, P. E.	...	Jarrow-on-Tyne
GATES, F. R.	c	London
HILL, J. R.	...	London
PIKE, H. W.	c	London
POGSON, J. W.	...	Oldham
REFFOLD, A. G.	c	London
ROBBINS, E.	...	London
TURNER, J.	...	South Shields
WILDING, J.	c	Liverpool
WINDRIM, A.	...	Belfast
YOUNG, A.	...	London

## Plumbers' Work.

ALLEN, W. H.	...	Roath
ALLISTER, S. J.	c	Huddersfield
ANDREWS, T. N.	c	Plymouth
AUBERTIN, H. F.	...	Ipswich
BACHE, A. E.	...	London
BAILLY, J. H.	...	Northampton
BARDSLEY, R.	c	Stockport
BARRETT, H. J.	c	London
BAYLIS, A.	...	Liscard
BEDFORD, E.	...	Leeds
BENNETT, S. B.	c	Darlington
BENT, T.	...	Leicester
BERRY, H.	c	Rochdale
BEW, R. H.	c	London
BISHOP, W. G.	...	Cardiff
BLACKMAN, H.	...	Brighton
BOTTOMLEY, A. E.	...	Swindon
BIGGS, J. B.	...	Derby
BRITTON, A.	c	Leeds
BROOKS, J.	...	Norwich
BROWN, A. A.	c	Barnsley
BROWN, R.	c	Edinburgh
BUTTERWORTH, A.	c	Wakefield
BYRNE, T.	...	Dublin
CAFFEY, J.	c	Armagh
CAIRNS, R. W.	c	Sunderland
CANHAM, G. E.	c	Norwich
CASS, C.	...	Manchester
CHAPMAN, H. G.	...	London
CHAPPELL, A. C.	...	London
CLARK, J. A.	c	London
CLARKE, J. W.	...	London
CLAY, H. H.	c	London
COBB, W. B.	c	Warrington
COLLINS, E. R.	...	London
COOK, F. C.	...	London
CORBRIDGE, W.	c	Bury
COX, F. E.	c	Brighton
CRABBE, W. G.	c	London
CROCKER, W. J.	c	Bournemouth

DIMENT, J.	...	Ealing
EARLY, D.	...	London
ESAU, H. W.	c	London
FAIRCHILD, S. O. G.	c	London
FAWLEY, F.	...	London
FIRTH, C.	...	Dewsbury
FIRTH, W.	...	Tottenham
FOGGIE, J.	...	Dundee
FORBES, A.	...	Aberdeen
FRANKLIN, E. J.	...	London
FRETWELL, W.	c	East Ham
GAMMIE, J.	c	London
GAYNER, W.	...	Bath
GOODING, T.	...	London
GRANGER, R. B.	c	Nottingham
GRANT, W.	c	Birmingham
GREEN, J.	...	Saltburn
GRIFFITHS, A. W.	...	Bristol
HAMBLYN, W. H.	...	Devonport
HAMLIN, F. C.	c	Weston-super-Mare
HAMMOND, W. H.	...	Wakefield
HARDING, W. J.	...	Banbury
HARMER, J.	c	Croydon
HARRISON, J. W.	...	Keighley
HART, J. W.	c	London
HERON, A. J.	c	Salford
HERRINGSHAW, A.	c	Manchester
HIND, H. W.	...	Stockton-on-Tees
HOGG, R.	...	Dublin
HOUGHTON, R. W.	c	Bootle
HUDSON, A. E.	c	Cheltenham
HUGHES, T.	c	Warrington
HUNT, G.	...	Cambridge
JAMES, C. T.	...	Barrow-in-Furness
JARVIS, E. J.	...	Plymouth
JOHNSON, L. W.	...	Gateshead
JONES, I. R.	c	London
JORDAN, E. T. D.	c	Walthamstow
KENNETT, J. A.	c	Thames Ditton
KING, A. E.	c	Bristol
KIRK, J. W.	c	London
LAIDLAR, E.	...	Durham
LARGE, D.	...	Chester
LEAT, H. C.	c	Bristol
LENEY, A. W.	c	Hove
LOW, I.	...	Glasgow
MACKAY, A. C.	...	London
MALCOLM, A.	c	Manchester
MARTIN, A. C.	c	Burton-on-Trent
MATHIAS, H. D.	...	Liverpool
MCADAM, G. E. R.	c	Berwick-on-Tweed
MCCULLOCH, F.	c	Glasgow
MILLS, C. H.	...	London
MILTON, E. E.	...	Richmond
MOORE, S. H.	c	Liscard
MOORHOUSE, E. F.	c	Halifax
MORRIS, W.	c	Southport
MOSS, W.	...	Stockport
MOSS-FLOWER, T. J.	c	Bristol
OWENS, W.	...	Pontardawe
PARKS, A.	c	Tunbridge Wells
PEARSON, H. A.	c	Walthamstow

PEERS, J. ...	c	Wolverhampton
PENNINGTON, W. H. c		Preston
PERMAN, E. ...	...	Newport (Mon.)
PERRY, W. H. ...	c	Sutton
PETERSON, T. L. ...	c	South Shields
PLUMB, F. G. ...	c	Coventry
POORE, C. T. ...	...	Acton
QUIRK, E. ...	c	Liverpool
RADCLIFFE, J. ...	c	Manchester
RAIMES, C. ...	c	Newcastle-on-Tyne
RAYNES, F. W. ...	c	Coatbridge
RILEY, H. ...	c	Burnley
ROBINSON, C. E. ...	...	East Ham
RUSHTON, E. ...	...	Cleethorpes
SALTER, R. B. ...	...	Hull
SANDERSON, R. ...	c	Preston
SAUL, J. D. ...	...	London
SAWYER, E. B. ...	c	Barry
SAYERS, A. ...	c	Belfast
SCARTE, J. R. ...	c	Pudsey
SCHOFIELD, J. T. ...	c	Rochdale
SCOTT, J. E. ...	...	Newcastle-on-Tyne
SCOTT, J. F. ...	c	Hamilton
SCOTT, W. ...	c	Guildford
SHARP, G. F. D. ...	c	Grimsby
SHERVILL, J. A. ...	...	Teddington
SIMPSON, W. ...	...	Aberdeen
SLOAN, T. M. ...	c	Cork
SMITH, G. ...	c	East Ham
SMITH, S. M. ...	c	Altrincham
STILLMAN, W. G. ...	...	Tunbridge Wells
STOREY, B. ...	c	Yarmouth
SUTCLIFFE, A. J. ...	c	Ealing
SWAIN, W. ...	c	Bath
SWINSON, E. T. ...	c	Feltham
TAYLOR, J. ...	c	Bury
TAYLOR, S. W. ...	c	Stockport
THOMAS, A. ...	...	Birkenhead
THURSTON, W. H. ...	c	Leyton
URWIN, J. ...	c	Newcastle-on-Tyne
UTTLEY, S. H. ...	...	Sheffield
UTTLEY, W. A. ...	c	Rotherham
VAUX, J. E. ...	...	Sheffield
WAKEFORD, W. T. ...	c	Gloucester
WALTER, A. ...	c	London
WANSBROUGH, C. S. ...	c	London
WATSON, R. W. ...	...	Weston-super-Mare
WATT, A. ...	c	Newcastle-on-Tyne
WATTS, A. G. ...	...	Newport (Mon.)
WATTS, W. E. ...	c	Newport (Mon.)
WEED, W. D. ...	c	Tottenham
WILCOCKSON, A. E. ...	...	Middleton
WILDE, A. J. ...	...	Liverpool
WILKINSON, A. G. ...	c	London
WILKINSON, W. ...	...	Derby
WISEMAN, H. L. ...	c	Birmingham
WOODHEAD, J. W. A. ...	c	Burton-on-Trent
WORTHINGTON, W. ...	c	Blackpool
WRIGHT, S. W. ...	c	Devonport
YOUNG, A. ...	...	London

## Pottery and Porcelain.

HOLDROFT, A. D. ...	Tunstall
JACKSON, W. ...	Tunstall
MELLOR, J. W., D.Sc. ...	Tunstall
RICHARDSON, A. G. ...	Tunstall
TURNER, F. ...	c Burslem

## Principles of Art as applied to Weaving.

BROOKES, A. E. G. ...	c Salford
CADNESS, H. ...	c Manchester
CARTWRIGHT, T. ...	A. R. C. A. Macclesfield
THOMAS, W. H. ...	Halifax

## Rail Carriage Building.

ARKWRIGHT, T. W. ...	c Wolverton
BECKLEY, W. W. H. ...	c Eastleigh
CARTER, R. ...	... Swindon
CORDELL, H. E. ...	c Manchester
DANIELS, T. H. ...	... Brighton
GOBEX, F. E. ...	... Manchester
HILL, E. O. ...	... Oldbury
HILL, T. P. ...	... Sheffield
JORDAN, T. ...	... Derby
MORTON, R. E. J. ...	c Ashford
PENTON, R. R. ...	... Barrow-in-Furness
PRICE, E. F. ...	... Leyton
SMITH, W. J. ...	c Derby
SNOW, W. R. ...	c Stratford

## Road Carriage Building.

BAILEY, E. ...	c London
BEDFORD, V. F. ...	c Newcastle-on-Tyne
BOTLEY, S. ...	c Liverpool
CLARK, E. ...	c Aberdeen
GODWIN, H. ...	... Wolverhampton
HEARD, A. E. ...	c Peterborough
HENDERSON, A. ...	... Glasgow
IRELAND, W. A. P. ...	c Bristol
JAMES, C. W. ...	... Worcester
JONES, E. W. ...	... Bath
LOVETT, W. M. ...	... Coventry
MARSDEN, A. ...	c Leighton Buzzard
MATTISON, T. ...	... Southampton
MEDLEY, R. ...	c Manchester
MILLIGAN, J. ...	... Newcastle-on-Tyne
MULLINER, A. F. ...	... Northampton
NORMAN, R. A. ...	c Birmingham
NORRIS, J. O. H. ...	... Manchester
O'GORMAN, J. F. ...	... Clonmel
PHILIPSON, J., Jun. ...	... Newcastle-on-Tyne
RICHARDSON, C. ...	... Leighton Buzzard
SHEPHERD, J. ...	c Dartford
SHINNIE, J. ...	c Aberdeen
SMITH, J. ...	... Aberdeen
THOMPSON, W. H. ...	c Northampton
THOMSON, G. D. ...	... Birmingham

## Shipbuilders Work.

BURNS, D. ...	Pollokshaws
CAMPBELL, J. ...	Wallsend-on-Tyne
FISHER, S. ...	Barrow-in-Furness
GREEN, G. A. ...	South Shields
HOBGEN, H. G. ...	Portsmouth
INCH, W. ...	Hull
MASTERS, W. H. ...	Southampton
MCCOLL, M. C. ...	Wallsend-on-Tyne
MCCURDY, J. H. ...	London
MOFOOT, A. ...	South Shields
MOWAT, A. G. T. ...	Barrow-in-Furness
MUIR, C. M. ...	Sunderland
SHADFORTH, W. ...	Barrow-in-Furness
SHEPHERD, F. J. ...	West Ham
SMITH, J. ...	Wallsend-on-Tyne
WARREN, J. S. ...	Devonport
YOUNG, J. ...	South Shields

## Silk Dyeing.

(See above under Dyeing.)

## Silk Throwing and Spinning.

BLACKWELL, W. ...	Macclesfield
HEWETSON, A. W. ...	Macclesfield
KERR, G. ...	Paisley
SADLER, A. R. ...	Macclesfield

## Silk Weaving.

HEWETSON, A. W. ...	Macclesfield
HEYS, E. E. ...	Manchester
KERR, G. ...	Paisley
SADLER, A. R. ...	Macclesfield
SHAW, A. ...	Macclesfield
SIDWELL, E. ...	Coventry
WALLWORTH, J. T. ...	Macclesfield

## Silversmiths' Work.

HOW, A. J. ...	London
STOYE, W. ...	London
WIGLEY, T. B. ...	Birmingham

## Soap Manufacture.

GADD, W. L., F.I.C. ...	Gloucester
NIGHTSCALES, T. A. ...	Hull
SEGALLER, D. ...	East Ham

## Structural Engineering.

ANDREWS, E. S. B.Sc. ...	London
BOSWALL, R. O. ...	London

DRURY, F. E. ...	Halifax
FERRIER, R. M., M.Sc. ...	Bristol
GRIFFITHS, D. N. ...	Darlington
HALER, P. J., B.Sc. ...	London
HANDY, C. E. ...	Portsmouth
KETH, D. A. ...	London
KIRK, P., M.A. ...	London
RICE, F. R. S. ...	London
SPRAGUE, E. H. ...	London
TOMLINSON, A., M.Sc. ...	Salford

## Sugar Manufacture.

ALLAN, J. ...	Manchester
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## Tailors' Cutting.

BATTERBEE, J. ...	Norwich
BYRNE, J. ...	Dublin
CRABTREE, O. ...	Hebden Bridge
DAY, E. C. ...	London
HAYGARTH, H. ...	Keighley
HOLLOCK, E. T. ...	Leeds
HORAN, P. ...	Dublin
MILLIN, A. ...	Oxford
PALMER, A. J. ...	Kettering
REZIN, J. ...	Tralee
RYAN, J. ...	Limerick
SCOTT, A. J. P. ...	Brighton
SPENCE, C. H. ...	London
THORNTON, J. P. ...	London
UMBACH, A. ...	London

## Telegraphy and Telephony.

ADDEY, F., B.Sc. ...	London
ALBERY, R. H.* ...	Warrington
ANDREWS, T. N. ...	Plymouth
ASHWORTH, J. R., M.Sc. ...	Rochdale
BAILEY, W. J. ...	Bradford
BAILY, F. G., M.A. ...	Edinburgh
BELL, J. ...	Southampton
BELLWOOD, G. F. ...	Sunderland
BINNINGTON, T. C.* ...	Hull
BLACKBURN, R. S. ...	Hebden Bridge
BOWER, W. R., A.R.C.S. ...	Huddersfield
BROWN, J. T. ...	Chiswick
BURROW, S. E. J. ...	Lowestoft
CHALDER, M. ...	Newcastle-on-Tyne
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COLLINS, R. ...	Exeter
COWIE, J. ...	Brighton
CROUCH, A. ...	London
CRUICKSHANK, W. ...	London
DAVIES, D. O. S. ...	Norwich
DAVIES, H., B.Sc.† ...	Portsmouth
DIXON, E. H., B.Sc. ...	Southampton
DOLTON, W. ...	London
DRYSDALE, C. V., D.Sc. ...	London

EVES, W. J. ...	c	Smethwick
FEW, H. P. ...	...	London
FINDLEY, G. F. ...	c	Aston Manor
FRASER, J. ...	...	London
GAITER, J. ...	c	Aberdeen
GEE, W. W. H., M.Sc.		Manchester
GRESSWELL, F. P. ...		Hanley
HARDIE, J. J. ...	...	London
HARRIS, J. ...	...	Swansea
HARROP, F. N. ...	c	Manchester
HAY, C. E. ...	...	Ilford
HEWSON, F. ...	...	Leicester
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HITCH, W. E. ...	c	Oxford
HOLT, F. B. ...	...	Derby
JACKSON, H. A. ...	...	East Kirkby
JEFCOAT, C., A.R.C.S.		Belfast
JOHNSON, E. J. ...	...	Sheffield
KENNEDY, D. H. ...	c	London
LARKMAN, A. E. ...	2	Birkdale
LAWSON, R. ...	c	Manchester
LEGGETT, S. C. ...	...	Bolton
MACDONALD, G. J. ...	c	Portsmouth
MACDONALD, R., M.A.		Kingstown
MANSBRIDGE, G. F.		Croydon
MARTIN, H. E.* ...	...	South Norwood
MASAROON, R. G. ...	...	Bristol
MAYMAN, A. C.† ...	c	Hull
MILLS, H. L.* ...	...	Southampton
MITTON, F. E. ...	c	Croydon
MOGG, G.* ...	c	Bristol
MORGAN, C. E.† ...	...	Bristol
NEWTON, E. I. T. ...	c	Guildford
NICHOLAS, S. W.* ...	...	Newcastle-on-Tyne
PEARSON, G. A.* ...	c	Hull
PEERS, G. R. ...	...	Manchester
PHILLIPS, J. L. ...	...	South Norwood
PICKERSGILL, J. W. ...	c	Leeds
PRATT, A. G. ...	...	Bristol
PULFORD, A. R.† ...	c	Belfast
RICHARDSON, S. S., B.Sc. ...	c	Liverpool
RIDD, W. J. ...	...	London
RILEY, J. T., D.Sc. ...	...	Hull
ROBERTS, A. H. ...	...	Birmingham
ROBERTSON, J. M. ...	c	Liverpool
SCUTT, W. D.† ...	c	Leeds
SHAUGHNESSY, E. H.		London
SIMMANCE, J. H. ...	...	London
SMITH, J. ...	c	Edinburgh
SORRELL, J. E. A. ...	...	North Walsham
STEVENS, W. A. ...	...	Maidstone
STUBBS, W. J. ...	...	Manchester
THOMAS, C. H.* ...	c	Leeds
TODD, E. W. J. ...	...	Staines
TWELLS, W. E. ...	...	Wimbledon
VITY, R. T. ...	...	Sheffield
WALLACE, G. S.† ...	...	Manchester
WALMSLEY, R. M., D.Sc. ...	c	London
WHITCHURCH, G. ...	c	Exeter

WHITE, W. J. ...	c	London
WHITEHOUSE, W. H. ...	c	Birmingham
WILSON, H. ...	c	London
WILSON, S. ...	...	Belfast

\* Registered for Telegraphy only.

† Registered for Telephony only.

## Typography.

ALEXANDER, E. R. ...	c	London
AMERY, W. H. ...	c	London
AUSTIN, R. ...	c	Preston
BASKETT, G. W. ...	...	Colchester
BIGGART, A. ...	...	Norwich
BIRKHEAD, R. ...	c	Halifax
BLACKSHAW, C. ...	...	Bolton
BLAKE, R. ...	...	Dalton-in-Furness
BRETT, W. B. ...	...	Kelvedon
BRUCE, J. ...	c	Leicester
BRUFF, F. H. ...	c	Bourneville
CHADWICK, J. R. ...	c	Leeds
CLARKE, A. W. ...	c	Leamington
COWELL, W. C. ...	...	Oxford
CURTIS, P. P. ...	c	Dublin
DANGERFIELD, F. J.		St. Albans
DAVIES, W. ...	c	London
DAWE, E. A. ...	...	London
DERRY, H. ...	...	Nottingham
EWART, W. ...	...	London
FISHER, E. ...	...	Harrogate
GARNER, A. H. ...	...	Rochdale
GOEBY, F. ...	...	Leamington
GOTTS, J. B. ...	...	London
HAMILTON, G. W. ...	...	Heworth
HARTLEY, S. W. ...	...	Wallington
HARVEY, J. ...	c	Cork
HENDERSON, F. ...	c	Aberdeen
HILBORNE, A. E. ...	...	Northampton
HUTT, E. E. ...	...	Weston-super-Mare
JONES, H. T. ...	c	Bristol
KING, P. H. ...	c	Oxford
KINLAY, J. ...	...	Dublin
LAWTON, E. ...	...	Manchester
LLOYD, A. E. ...	...	Derby
MARTIN, S. A. ...	c	London
MASON, G. W. ...	c	Gateshead
MUIR, J. ...	...	Greenock
NELSON, G. F. ...	...	Preston
PARIS, T. ...	...	Edinburgh
PARKER, H. F. ...	c	Reading
PARKHILL, J. ...	...	Belfast
REED, H. T. ...	...	Kingston
ROBERTS, C. E. ...	c	Batley
SELVEY, H. ...	c	Derby
SHEPARD, F. G. ...	c	London
SLATER, W. H. ...	c	London
SMART, E. L. ...	c	Liscard
TOMKINS, E. ...	c	Brighton
WARD, J. W. G. ...	...	Liverpool
WEIR, A. ...	...	Edinburgh



WILKINSON, H.	c	Thornaby-on-Tees
WIMHURST, E. N.	c	Harrow
WINNING, W.	...	Edinburgh
WINSOR, G.	...	Hull

### Watch and Clock Making.

CURZON, A. W.	c	London
HERRMANN, I.	...	Tunbridge Wells
HIGGS, G.	...	Liverpool
HOBBINS, J. H.	...	Manchester
MORRISON, E. J.	c	London
RANNS, J. E.	c	Hull
SMITH, W. K.	c	Edinburgh

### Wheelwrights' Work.

BOTLEY, S.	...	Liverpool
CARTER, R.	...	Swindon
GATWOOD, A. E.	c	London
HICKMAN, W. J.	...	London
MILLER, P. W.	c	London
SWANN, G.	...	London

### Wool Dyeing.

(See above under Dyeing.)

### Woollen and Worsted Spinning.

APPLEYARD, F.	c	Morley
ARMITAGE, E.	...	Huddersfield
BAILEY, J.	...	Keighley
BEDFORD, J. S.	...	Keighley
BELL, A. M.	...	Halifax
BRADBURY, F.	...	Belfast
BRADLEY, J.	...	Crosshills
BRIERLEY, S.	...	Huddersfield
BROADBENT, L.	...	Bury
FOX, T. A.	...	Leeds
GRAYSON, W.	c	Bradford
HOLLIS, T.	...	Shipley
HOLLOWAY, H. P.	...	Leeds
HOYLE, J.	...	Colne
KERR, G.	...	Paisley
LAYCOCK, J. F.	...	Bingley
MCVANN, J. T.	c	Keighley
MIDGLEY, E.	...	Shipley
OLIVER, T., D.Sc.	c	Galashiels
RADCLIFFE, J. W.	c	Dewsbury
SMITH, G. R.	c	Ossett
THORNTON, J. W.	...	Huddersfield

TINDALL, A. R.	...	Trowbridge
TURNER, H.	...	c Halifax
WASHINGTON, G.	...	Dewsbury
WHITWORTH, A.	c	Rochdale
WILBY, J. W.	...	Ossett
WOODHOUSE, T.	...	Dundee

### Woollen and Worsted Weaving.

ANDERSON, R. A.	c	Galashiels
ANDISON, T. B.	...	Galway
APPLEYARD, F.	c	Morley
ARMITAGE, E.	...	Huddersfield
ARNOLD, J. C.	...	Keighley
BAILEY, J.	...	Keighley
BARRETT, E.	...	Rochdale
BEDFORD, C. L.	...	Bradford
BELL, A. M.	...	c Halifax
BRADBURY, F.	...	Belfast
BRADLEY, J.	...	Keighley
BRIERLEY, S.	c	Huddersfield
BROWN, T.	...	Glasgow
CLAUGHTON, J.	...	Bradford
CLOUGH, M. S.	...	Shipley
DAVIS, W.	...	c Hawick
DYSON, B.	...	Huddersfield
FLETCHER, J. F.	c	Keighley
FOX, T. A.	...	Leeds
HARRIS, J.	...	Salisbury
HEYS, E. E.	...	Manchester
HOLLIS, T.	...	Shipley
HOLLOWAY, H. P.	c	Leeds
KERR, G.	...	Paisley
LAW, W.	...	Leeds
LAYCOCK, J. F.	...	Bingley
MIDGLEY, E.	...	Shipley
OLIVER, T., D.Sc.	c	Galashiels
PREST, F. W.	...	Bradford
ROBERTS, T.	c	Huddersfield
SCOTT, W.	...	c Bradford
SNOWDON, J.	...	Huddersfield
SPENCER, P.	...	Keighley
STOKER, P.	...	c Glasgow
SUTCLIFFE, A.	...	Halifax
THORNTON, J. W.	...	Huddersfield
TINDALL, A. R.	c	Trowbridge
WASHINGTON, G.	...	Dewsbury
WIDDOP, L. A.	...	Halifax
WILBY, A.	...	c Ossett
WILBY, J. W.	c	Ossett
WILSON, J. G.	...	Birstall
WOODHOUSE, T.	...	Dundee
YEWDALL, A.	...	Leeds

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